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Welsh Birds

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Edited by Stephanie J. Tyler

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'Woodlark at a site near Trellech in Monmouthshire' by Ray Armstrong

Text illustrations by Colin Richards and Steve Roberts

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EDITORIAL

I hope that I can continue with the high standard set by Graham Williams during his six years as Editor and prior to Graham, by Mike Shrubb. They both have managed to not only find material to fill many volumes of *Welsh Birds* but they have produced these on time. I have had a baptism of fire with promised contributions either not materialising or not being sent until the end of May or even into June, just at the time when I want to be in the field! Anyway for reasons beyond my control, please forgive the lateness of this issue.

I thought I would check through the volumes since 1988 to see which taxonomic groups figure most prominently. It will not be surprising to readers of *Welsh Birds* that of 98 papers and notes, a very large proportion – 31 (32%) – have been about raptors and owls. Ten have been on corvids, notably Ravens and nine on both seabirds and waders. Black Grouse have been the subject of four contributions and Nightjars of three. There have been 12 more general papers on birds of specific locations or habitats, four on status and population changes in Welsh birds and two that do not fit into any category (game books; colonisation and extinctions). It surely needs remedying that only 12 papers have been on species of passerines (other than corvids) from Dippers to Hawfinches, with three on Ring Ousels and one or two notes or papers on Skylark, Grey Wagtail, Pied Flycatcher, tits and Whinchats.

It was good to receive the paper on Goosanders on the River Wye, by Carl Mitchell, Baz Hughes and Tony Cross. This superb river bird continues to consolidate its hold as a breeding bird in Wales with pairs now well established too on lower Wye tributaries as the River Monnow.

Andrew Dixon and colleagues have produced a useful critique of the national survey results for Peregrines in Wales which will be of particular interest to raptorphiles.

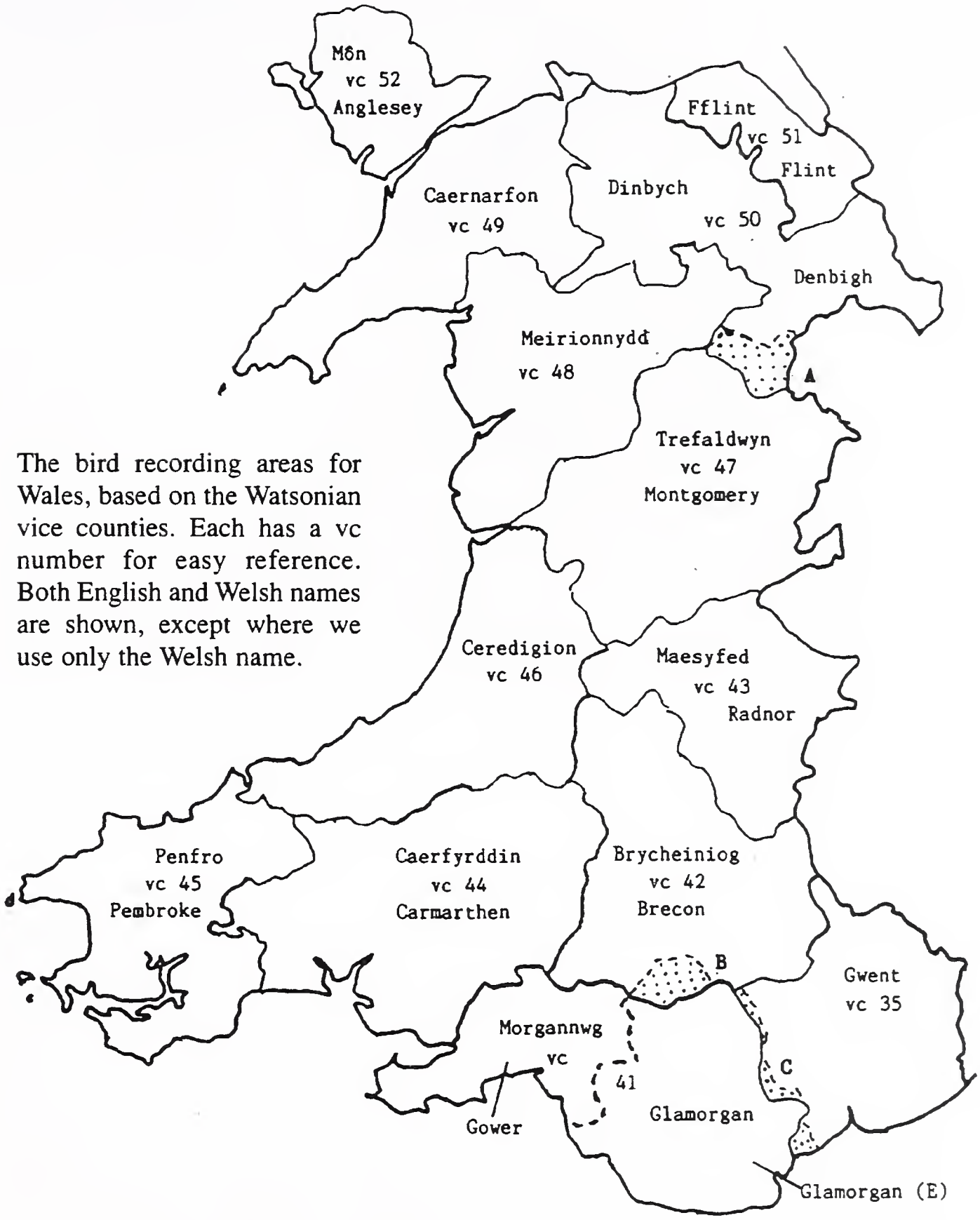
Jon Green has done a mammoth task of searching the literature for impacts of climate change on Welsh birds and has also produced a flattering review of the new publication, *The Birds of Gwent*.

The Welsh results of the national survey of Golden Plover and Dunlin and of Woodlarks and Dartford Warblers by RSPB research staff will be of interest to all W.O.S. members, as too the paper on key areas for birds in Wales. I hope this last paper stimulates every member to submit records of all the species mentioned.

I thank Graham Williams and Jon Green for much helpful advice and I thank too all the authors of papers in this issue and especially Ray Armstrong for allowing me to use his photos of Woodlarks at a Monmouthshire site in 2006 and Colin Richards, Jon Green and Steve Roberts for their attractive illustrations.

Stephanie Tyler

The Bird Recording Areas in Wales



The bird recording areas for Wales, based on the Watsonian vice counties. Each has a vc number for easy reference. Both English and Welsh names are shown, except where we use only the Welsh name.

GOOSANDER BROODS ON THE RIVER WYE, 1990-2000 AND A SUMMARY OF WELSH RINGING RETURNS

Carl Mitchell[1], Baz Hughes[1] & Tony Cross[2]

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SUMMARY

During 1990 to 2000, Goosander broods were counted and caught on a 25km stretch of the River Wye, mid-Wales. Occupancy averaged one brood per 6km of river and was similar throughout the study period. The mean brood size was 6.3 ducklings. In all, 113 ducklings (and six adult females) were caught and ringed, a capture rate of 50%. Goosander ringing on the River Wye during the study period accounted for 8% of the total number ever ringed in Britain. There were fourteen Goosander ring-recovery movements both to and from Wales. Most movements were in a broad NNE-SSW direction, possibly reflecting the route of initial colonisation. The colonisation of upland Wales in the early 1970s by Goosanders probably comprised individuals on the western fringe of the European range from northern England or Scotland. Three movements to Wales involved birds moving from the north of England to central Wales. Juvenile dispersal also appears to show a similar directional attachment with three of four recoveries of birds ringed as ducklings on the River Wye involving movements to the north or north-north-east in the first winter following capture.

INTRODUCTION

Interest in the population of Goosanders *Mergus merganser* frequenting the rivers of mid-Wales has increased in recent years. Since breeding was first proven in Wales in the early 1970s (Lovegrove *et al.* 1994), the range and number of Goosanders using the rivers throughout the year has increased (e.g. Tyler *et al.* 1988, Underhill 1993).

Systematic counts and surveys have revealed, to some extent, the abundance, phenology and habitat use of Goosanders in mid-Wales (e.g. Tyler *et al.* 1988, Underhill 1993), however certain aspects of the biology of these birds remains unexplored. In particular the movements of Goosanders both within and outwith Wales are poorly understood. Similarly, year on year changes in productivity on key stretches of rivers have not been reported.

This short note describes annual counts, productivity, ringing and movements of birds caught on a stretch of the River Wye, in mid-Wales between 1990 and 2000.

METHODS

A 25km stretch of the River Wye between Dolfach (SH9177) and 2km north of Newbridge on Wye (SO0159) was walked each year (except 1991 and 1998) in early July (Fig 1). The stretch of river is relatively shallow, fast flowing with an average descent of 3.6m per 1km, and has a stony substrate with many riffle sections. The mean river width, measured at 1km intervals, was 33m ($\pm$1.1m se, n=26). Much of the river banks are wooded, or open managed grassland. The capture procedure involved a team of two to six fieldworkers walking a stretch of river, along banks and wading in the water, until a brood was located. All sightings of adult and duckling Goosanders were noted, in case attempts to capture birds failed. A mist net was erected downstream of the brood, covering a stretch of shallow river. The brood and attendant female were then driven towards the mist net. Ducklings that could safely be ringed were over four weeks in age. After ringing, wherever possible, all members of a brood were released together to promote family cohesion. Brood sizes were log transformed and differences between years were tested using ANOVA.

RESULTS

The mean number of broods encountered was 4.38 (n=33, sd =0.49, range = 2-7), or approximately one brood per 6km of river. The mean number of birds encountered, including attendant adult females, was 0.386 birds per hectare. The number of broods seen showed no significant trend during the study period (rs=-0.58, P>0.05). The mean brood size was 6.3 ducklings (Fig 2, n=35, sd =0.59, range = 1-16). The difference in annual mean brood size was not significant ($F_{7,25}$=0.48, P=0.84).

The capture rate was variable; adult females were caught infrequently, with six being caught in eleven years. On average, 12.6 ducklings were caught annually (Fig 3). In all, 113 ducklings were caught and ringed, out of 208 seen, a capture rate of 50%. In addition, a small number of broods were caught which were too young to ring. No birds were re-caught in a subsequent season on the study section of river.

To date, four recoveries (4% of those ringed), comprising one adult female and three ducklings, have been reported (Fig 4). In addition, and excluded from this study, at least

four ducklings and an adult female were shot in 1996 on the River Wye shortly after they were ringed under licence by researchers examining gut contents.

An adult female ringed in 1990 was caught alive in August 1992 during the moult period on the Eden Estuary, Fife (452km north). One bird, ringed as a duckling in 1993, was recovered in south west Norway in October, two years later. The bird was not sexed at the time of capture but was probably a male returning from the moult gathering in the four large fjords around the North Cape (Little & Marchant 2002). The two other birds, ringed as ducklings, involved relatively local movements; one was found 24km north, five months later; another moved 58km south-west in 49 days. A duckling caught 10km east of Machynlleth in July 1986 (and not part of this study) was recovered 265km north, just north of Carlisle, Cumbria, in January of the following year. Another duckling (again, not part of this study) was ringed in July 1990, near Aberystwyth, and had moved 91k north-east to Chirk, Clwyd, seven months later.

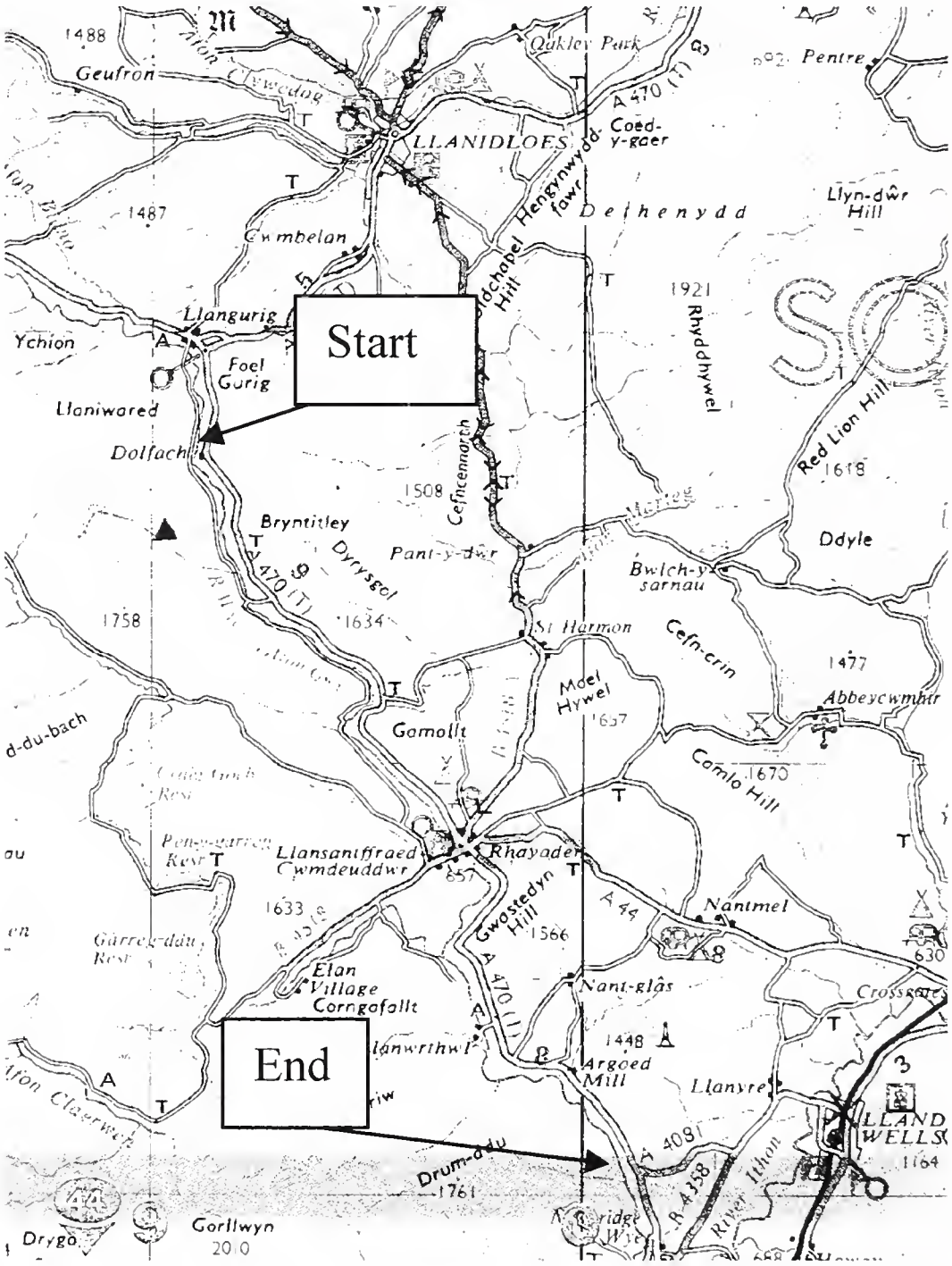

Figure 1. Location of study site: a 25km stretch of the River Wye between Dolfach (SH9177) and 2km north of Newbridge on Wye (SO0159). The mean river width was 33m (± 1.1m)

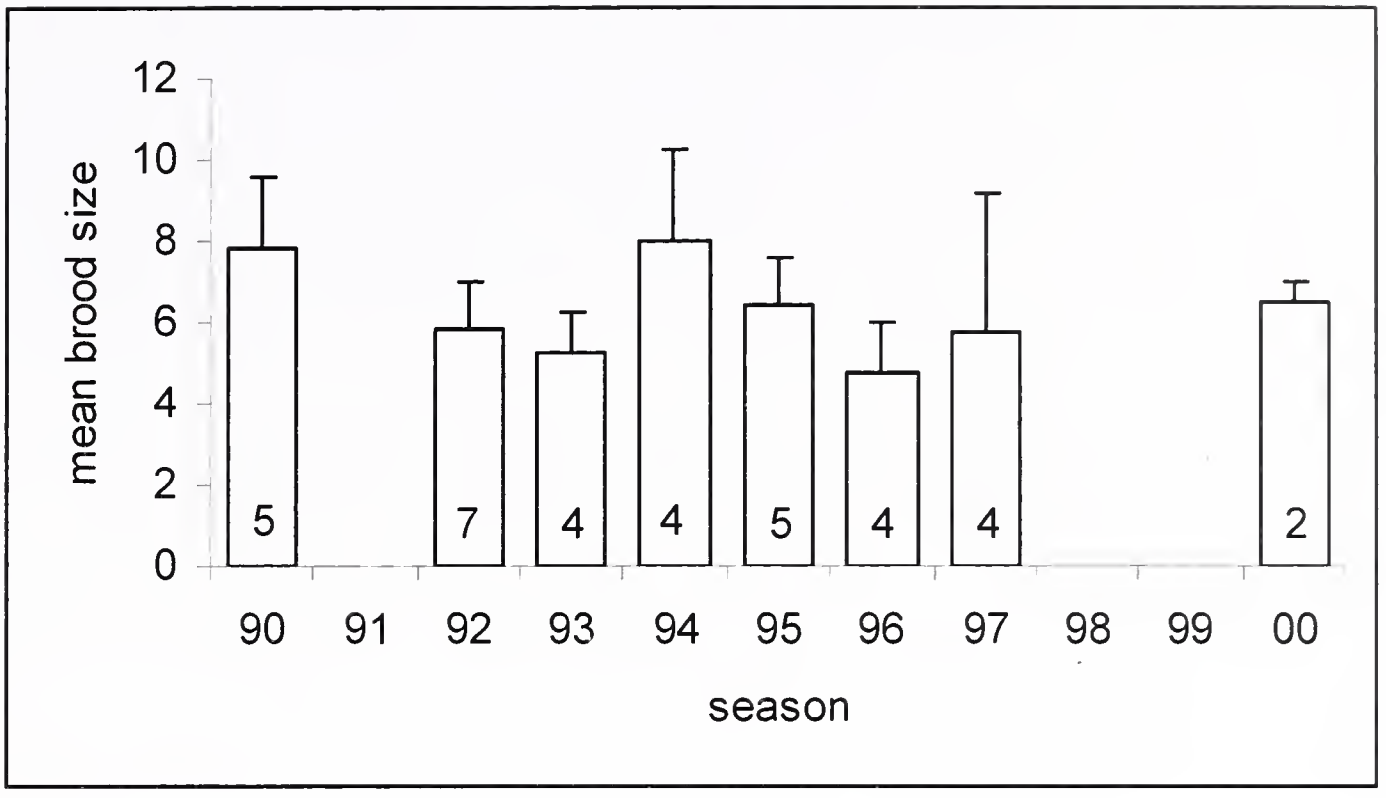

Figure 2. Mean brood size (+ se) of Goosanders on a 25km stretch of the River Wye, mid-Wales, 1990-2000. Sample sizes shown inside bars.

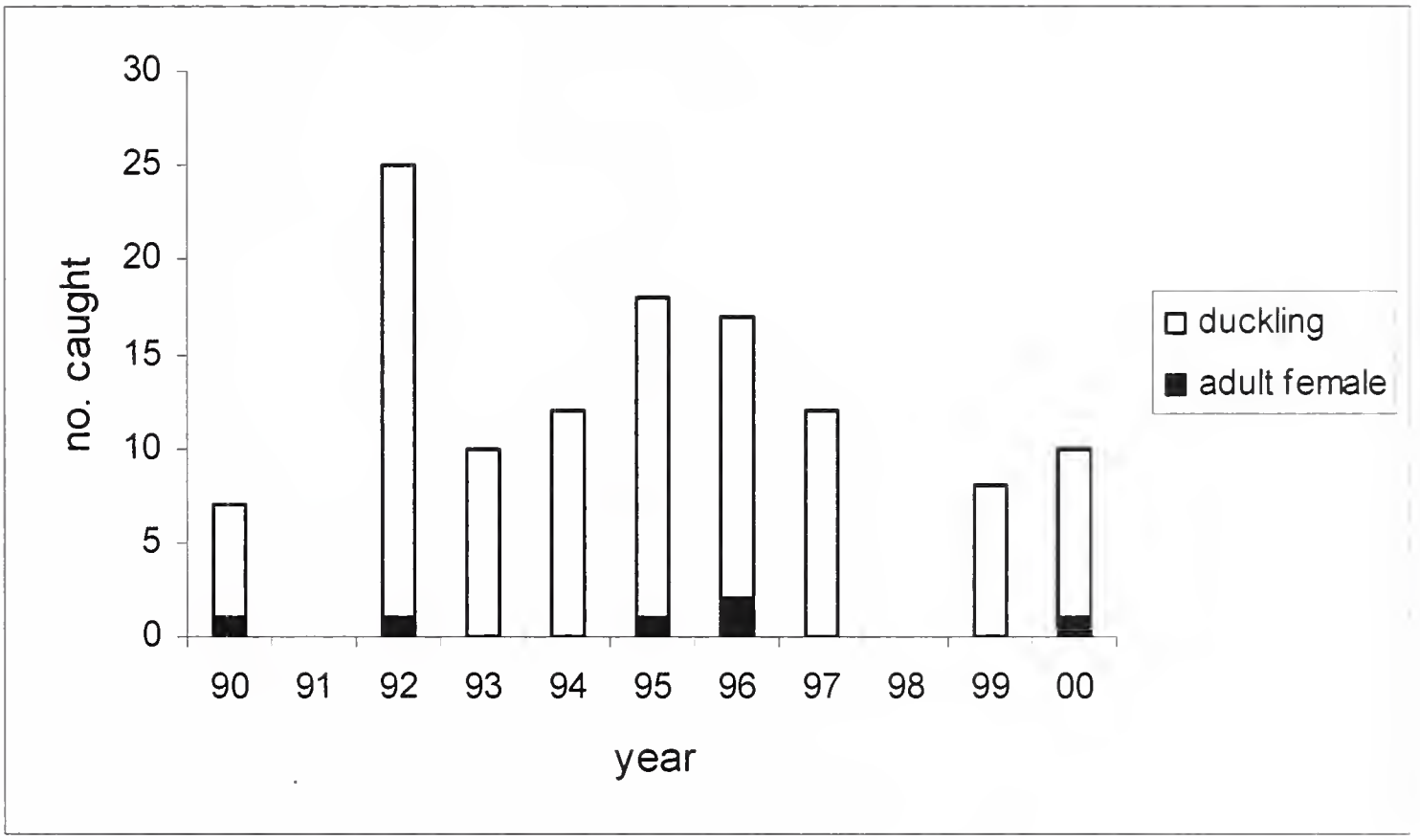

Figure 3. Capture totals of Goosanders on a 25km stretch of the River Wye, mid-Wales, 1990-2000.

Three Goosanders ringed elsewhere in Britain have been recovered in Wales (Fig 4). An adult female ringed near Kirkby Lonsdale, Lancashire, in May 1996 was found dead 265km south-west near Llandysul in January eight months later. An adult female trapped in July near Kielder Water, Northumberland, was recovered in May, three years later near Chirk, Clwyd. A duckling ringed near Haydon Bridge, Northumberland, in July 1978 was shot at Talybont-on-Usk, Breconshire in the following December. The direction of travel within Britain was on a bearing approximately NNE-SSW (Fig 4, n=8, excludes the movement to Norway).

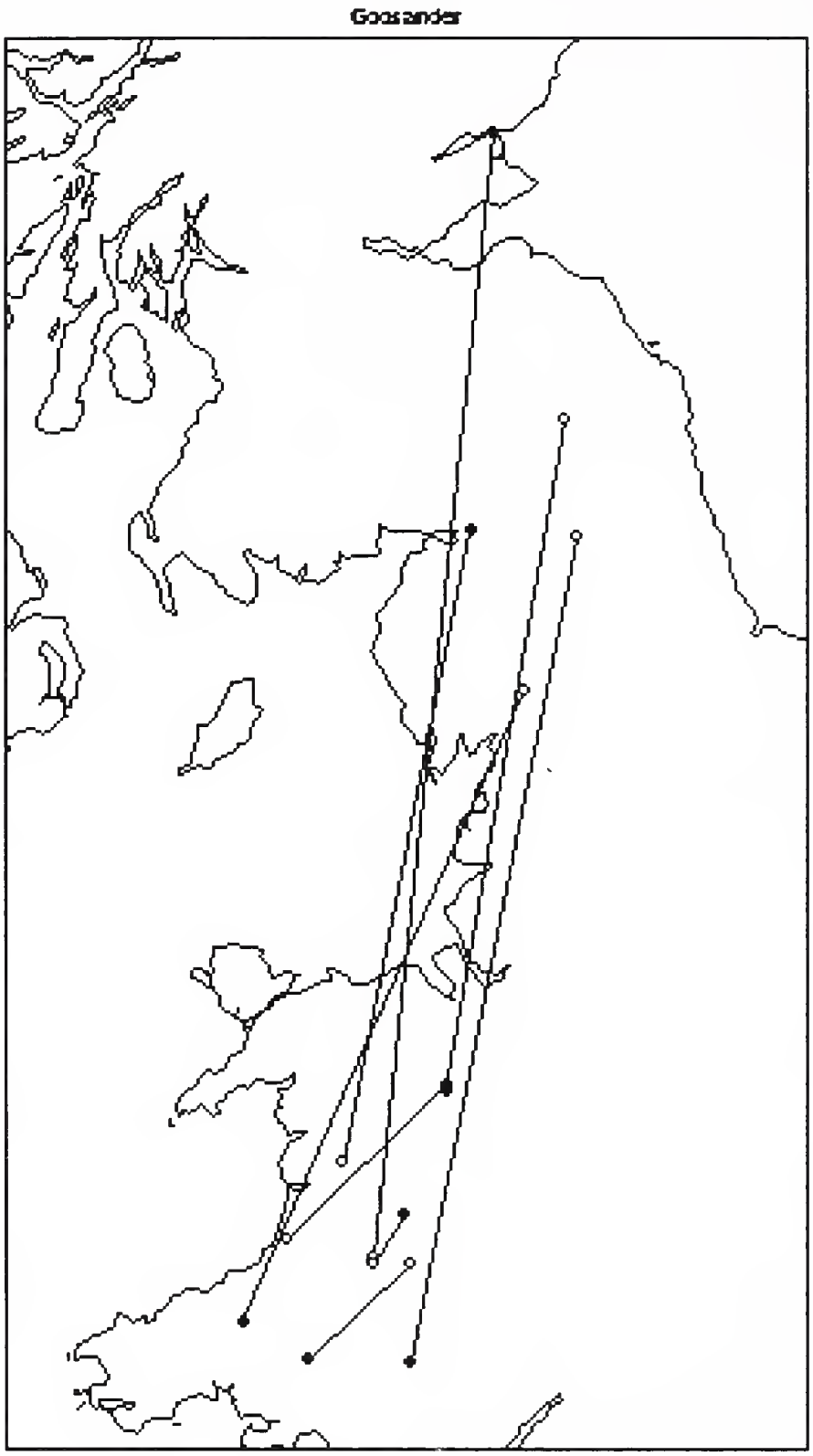

Figure 4. Movements of Goosanders to and from Wales. Open symbols (○) show capture location. Closed symbol (●) show recovery location. One Goosander ringed as a ducking on the River Wye, and recovered in south west Norway (58°47'N 5°56'E) is not shown.

DISCUSSION

It is unlikely that any broods were missed during the surveys. Beaters moved downsteam towards mist nets and most broods moved ahead of the beaters and were either seen by the beaters or by those attending the nets. Hens and broods were remarkably faithful to certain stretches of river; when disturbed they would often move just ahead of the beaters but just out of sight. The mean brood size (6.3 young) was somewhat smaller than the mean clutch size of 8-12 eggs (Titman, 2005), indicating some eggs fail to hatch or losses of ducklings occurred in the first few weeks after hatching, although similar to that recorded in other studies in Britain. On the Rivers Dee (Aberdeenshire) and North Esk (Angus & Dundee) the mean brood size was between 6.1 and 7.4 young (Marquiss *et al.* 1998) and on the River Tweed (Borders), mean brood sizes were 7.3 and 5.6 young in 1984 and 1987 (Murray 1988). Tyler (1987) recorded a mean brood size of 6.5 on the Tywi (Wales) in 1986.

The occupancy rate of one brood per 6km of river (or 0.386 birds per ha) remained similar during the study period suggesting that either breeding, or brood rearing, density may have reached a carrying capacity. The density of birds on the River Wye (Fig 5) was similar to that encountered on the River Dee (Aberdeenshire) (Marquiss *et al.* 1998). Densities on the main duckling rearing areas of the River Tweed were one brood per 5km on the Teviot tributary system and one per 9km on the main stem in 1987 (Murray 1988). Tyler reported a density of one brood per 6 km on the River Tywi in 1986.

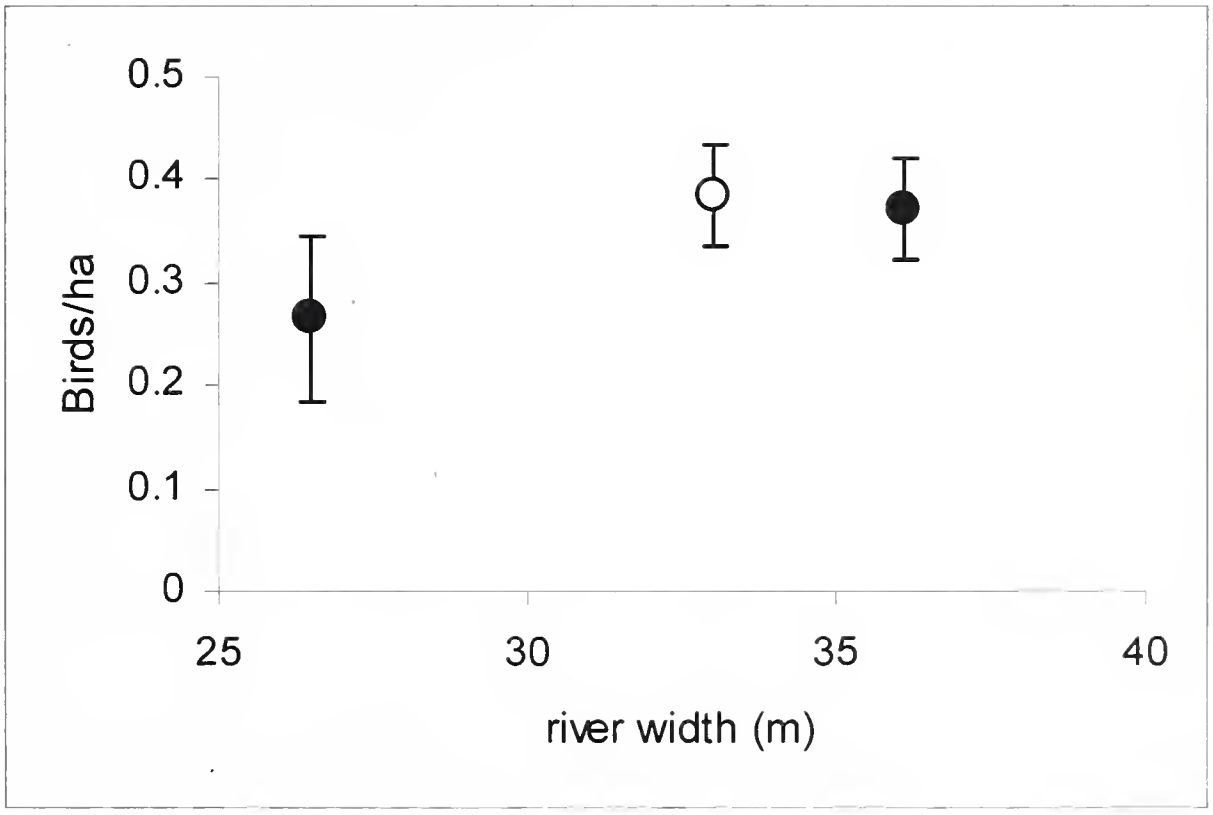

Figure 5. The density of Goosanders encountered on the River Wye (○) compared to that of the River Dee (●), Aberdeenshire (from Marquiss et al. 1998)

During this study, Goosander ringing on the River Wye accounted for 8% of the total number ever ringed in Britain. Perhaps of more importance is that during the eleven

years of ringing, the Wye study accounted for 80% of all ducklings ringed in Britain during that period.

Over most of its range in north-west Europe the Goosander is either resident or moves short distances between breeding and wintering areas. There has been little ringing in continental Europe but the evidence indicates a movement of Scandinavian breeding birds into the Baltic, Germany, the Netherlands and Britain in winter. A few Scandinavian-ringed birds have been recovered in Britain, from the north of Scotland to Suffolk - enough to suggest a regular immigration in winter, mainly to the southern half of Britain, with birds arriving in November to January and departing during March (Little & Marchant, 2002). The monthly pattern of winter numbers confirms that there is an influx in January, and in some years in February, and that this is largely in the south of Britain (e.g. Banks *et al.* 2006).

Movements within Britain of birds ringed in Northumberland during the breeding season, were largely to the north and west, mostly around the Scottish borders, on average about 100km from the ringing place (Meek & Little 1977). However, some ducklings and adults ringed in Northumberland moved south during the winter into England. Evidence from ringing during the breeding season in Northumberland suggests that natal philopatry was high. Moulting females were caught on the Eden Estuary during 1992-94. Subsequent sightings showed movements to the south and west during the winter and breeding seasons (Hatton & Marquiss 2004).

The adult female caught in 1990 on the River Wye with a brood and subsequently controlled moulting on the River Eden in 1992, lends support to the suggestion that early and failed breeding females moult in Scottish estuaries (Little & Marchant 2002). The increase in breeding numbers in Wales from the 1980s concords with an increase in the number of moulting females recorded on the Tay, Eden and Tyninghame estuaries, Montrose Basin and Moray Firth (Hatton & Marquiss 2004). Presumably late breeding females moult on Welsh rivers, as has been demonstrated in Scotland (Marquiss & Duncan 1994).

It is therefore possible that the recent colonisation of upland Wales by Goosander comprises individuals on the western fringe of the European range from northern England or Scotland. Three movements to central Wales involved birds moving from the north of England. Juvenile dispersal also appears to show a similar directional attachment with three of four recoveries of birds ringed as ducklings on the River Wye involving movements to the north or north-north-east in the first winter following capture.

Little is known about the wintering destination of Goosanders breeding in this part of mid-Wales. Maintaining an annual cohort of ringed individuals, perhaps using colour-marking techniques, from this pioneering population is essential if more is to be learned about their movements.

ACKNOWLEDGEMENTS

Thanks are due to many folk who have helped catch Goosanders over the years; stalwarts include Nigel Jarrett, Ruth Cromie, Justine Millard and Des Callaghan. Drs Steph Tyler and Mick Marquiss kindly improved an earlier version of the manuscript.

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THE NATIONAL PEREGRINE SURVEY 2002: HOW ACCURATE ARE THE PUBLISHED RESULTS FOR WALES?

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SUMMARY

Previously published estimates for the number of pairs of Peregrines in Wales during the National Peregrine Survey in 2002 differed by 10% i.e., 321 *cf.* 288 pairs reported by the Wales Raptor Study Group and BTO respectively. The under-estimate was greatest for inland breeding areas, where the difference was 15% i.e., 232 *cf.* 198 pairs. For the South Wales Peregrine Monitoring Group study area in south-central Wales we compiled a comprehensive database of Peregrine breeding sites using our own survey data, together with data from the BTO and RSPB. We then compared this 'definitive' SWPMG database with the BTO data from the 2002 National Survey for the same area. The 2002 National Survey underestimated the number of pairs in the study area by nearly 7%. For the rest of inland South Wales we estimate that the 2002 National Survey underestimated the number of pairs by at least 29%. We discuss the causes of this significant degree of under-recording and suggest that future surveys incorporate a methodology that enables confidence intervals to be determined for the population estimate.

INTRODUCTION

After the British Trust for Ornithology's Peregrine Enquiry of 1961-62 a second national census was undertaken in 1971 and subsequently the Peregrine has been the subject of decadal national surveys in 1981, 1991 and 2002 (the latter postponed in 2001 due to the outbreak of foot and mouth disease). The original Peregrine Enquiry documented the population crash induced by pesticides (Ratcliffe, 1963) and the subsequent surveys have charted the marked recovery in numbers nationally (Ratcliffe, 1972; 1984; Crick & Ratcliffe, 1995; Banks *et al.*, 2003). The five national surveys have provided up-to-date population estimates and have also provided a means by which the Peregrine population of the UK can be monitored to highlight regional population changes and perhaps also to indicate incipient changes in the quality of the wider environment (Crick *et al.*, 2003). Government agencies, conservation organisations and Peregrine researchers rely upon the accuracy of these national survey results. However, as the Peregrine population increases it becomes more difficult for volunteer surveyors to cover all the potential Peregrine territories such that the accuracy of the decadal population estimates may decline with each successive survey. In 2002 there was some validation work carried out in Scotland, a region where complete coverage was likely to be most difficult because of the remoteness and inaccessible nature of many sites (Crick *et al.*, 2003).

In Wales, there has never been any form of validation of the National Survey results, possibly because it was felt that the nature of the breeding sites are amenable to accurate coverage by volunteer surveyors. However, complete coverage does not only depend on the accessibility of the Peregrine sites but also on the survey effort. In Wales, since 1991, the National Surveys have been organised and conducted at a county level. Consequently, there is scope for variation in survey effort between counties, depending upon on the number and competence of available surveyors and the effectiveness of county co-ordinators. The potential for variation in coverage due to surveyor effort is exacerbated by the increase in Peregrine numbers, which may also vary from county to county. In this paper we wish to draw attention to some apparent discrepancies and inaccuracies in relation to the status of the Peregrine in Wales as reported from results of the 1991 and 2002 National Surveys. We highlight the different published results of major conservation organisations reporting on the National Peregrine Survey i.e., the BTO results for 1991 and 2002 (from Banks *et al.* 2003), RSPB results for 1991 (Williams, 1992) and the Wales Raptor Study Group results for 2002 (WRSG; Thorpe & Young, 2004). In addition, we compare the 2002 results to a database compiled by our South Wales Peregrine Monitoring Group (SWPMG) within a study area in south-central Wales.

METHODS

It should be recognised at the outset that there are certain ambiguities in the published results of the national Peregrine surveys, which we could not resolve. One of the first problems that we encountered when examining the survey results was that the BTO, RSPB and WRSG have used different criteria for dividing Wales into smaller geographical regions. The RSPB have used the pre-1974 county system (Williams, 1992), the WRSG have used the vice-county system (Thorpe & Young, 2004), whilst the BTO have divided the principality into two regions i.e., North and South Wales. Unfortunately, the regional division of Wales used by the BTO does not correspond with the divisions used by the RSPB or the WRSG. The BTO division of Wales cuts

through the vice-county of Montgomeryshire, following the main roads from Shrewsbury to Machynlleth via Newtown, thus some of the Peregrines breeding in this county will be included in the BTO total for North Wales and others in their total for South Wales.

We (the SWPMG) compiled data on Peregrines in our south-central Wales study area from a wide variety of sources (see Dixon *et al*, 2006 for further details), and in relation to the survey year of 2002 we received data from the WRSG (data passed to us in 2004) and the BTO (data passed to us in 2005). Some of our own data relating to Peregrine occupancy of breeding territories in 2002 was collected after 2002. Consequently, the SWPMG database represents the most complete inventory available of Peregrine sites in our south-central Wales study area. We compared this SWPMG database with the 2002 BTO National Survey returns for the same area.

The National Peregrine population estimate for 2002 published by Banks *et al.* (2003) is based on records received during the National Survey and a calculation for known sites that were not visited. This calculation is carried out as follows: the recorded number of pairs at breeding territories is divided by the total number of breeding territories visited; this gives the proportion of visited sites that were occupied by pairs. The number of unvisited sites is then multiplied by this proportion to give an estimate for the number of these unvisited sites that were occupied. This estimate is then added to the actual recorded number to produce an overall estimate of pairs at breeding territories. However, there were reportedly no known Peregrine sites that were not visited in Wales in 2002 (Banks *et al*, 2003).

RESULTS

The RSPB reported a total of 280 occupied territories in Wales during 1991 (Williams, 1992), whereas the BTO estimated a total of only 263 occupied territories (data from Banks *et al*., 2003). The corresponding figures for 2002 were 321 territories reported by the WRSG and only 288 by the BTO (Table 1). This amounts to a 6% difference in the Welsh Peregrine population estimate reported by these organisations for 1991 and 10% difference for 2002. We were unable to break this down into a regional analysis because we do not know how many territories in Montgomery fell into either the North or South Wales regions used by the BTO. The degree of under-recording in the 2002 National Survey is particularly high in inland Wales, where the BTO reported 15% fewer occupied territories than the WRSG (198 *cf.* 232; Table 1). The WRSG dataset for 2002 included data supplied by the SWPMG but we do not know what proportion of the additional sites identified by Thorpe & Young (2004) came from other sources, but we can see from the data that at least 12 of the 33 additional sites were from inland South Wales.

The BTO National Survey data supplied to us included eight territories within SWPMG south-central Wales study area that were not checked during 2002, though we do not regard two of these as legitimate breeding territories. This is at odds with the assertion in Banks *et al.* (2003) that all known breeding sites in Wales were inspected in 2002.

In our south-central Wales study area we have identified 100 different Peregrine breeding ranges (Dixon *et al*., 2006), though this total includes a former breeding site within an opencast coal mine that has since been back-filled and another two sites at

which breeding had never been proved during or prior to 2002. Consequently, in 2002 there were 97 known breeding ranges that could have been occupied. For our study area, in 2002 the National Survey recorded the existence of 94 former breeding ranges. This total included three sites that we do not consider to be Peregrine breeding ranges: the grid reference for one site is a flat field with no potential nesting site anywhere nearby, another we believe to be either an irregular alternative for a known site or an erroneous site, and the third is an alternative for another known site. The 2002 National Survey database therefore lists 91 of the 97 ranges that we recognise in our south-central Wales study area.

Table 1. Summary of the data published by the RSPB, WRSG and BTO on Peregrine numbers in Wales during the National Peregrine Survey years of 1991 and 2002.

RSPB regions	BTO region	RSPB 1991		BTO 1991		WRSG 2002		BTO 2002	
		Coastal	Inland	Coastal	Inland	Coastal	Inland	Coastal	Inland
Anglesey	North Wales	9	2	23	110	11	3	23	93
Caernafon		13	28			10	26		
Denbigh		0	21			0	17		
Flint		0	2			1	5		
Merioneth		0	46			0	40		
Montgomery	South Wales	0	23	52	78	0	24	67	105
Brecon		0	16			0	21		
Cardigan		11	13			15	17		
Carmarthen		3	12			3	14		
Glamorgan		5	16			9	33		
Monmouth		1	7			0	11		
Pembroke		36	3			40	6		
Radnor		0	13			0	15		
RSPB total for North Wales excluding Montgomery		22	99			22	91		
RSPB total for South Wales excluding Montgomery		56	80			67	117		
WALES TOTAL		78	202	75	188	89	232	90	198
		280		263		321		288	

Of the six 'missing' sites within our south-central Wales study area that were not on the BTO list, five were occupied and one was unvisited in 2002. The 2002 National Survey data supplied to us by the BTO recorded 73 sites as occupied i.e., 50 breeding, 16 probably breeding and 7 singletons (Table 2). The 2002 National Survey database

provides an estimate of 71 pairs for south-central Wales in 2002, calculated as 66 observed pairs plus an estimated 5 pairs at six unvisited sites (i.e., 6 x (66/84) = 5). In comparison the SWPMG database records 80 ranges as occupied i.e., 59 pairs breeding, 17 probably breeding and 4 singletons, with a corresponding estimate of 79 pairs for the same area, calculated as 76 observed pairs plus an estimated three more at four unvisited sites (i.e., 4 x (76/92) = 3). Consequently, the 2002 National Survey underestimated the Peregrine population of our south-central Wales study area by 7%.

Table 2. Comparison between National Survey database and the SWPMG database for Peregrine breeding ranges in south-central Wales during 2002. * = one site excluded because it is an alternative site for a single pair and not two separate sites; ** = two sites excluded as unlikely or erroneous breeding ranges. Territory Status Codes used by the BTO are: A = No sign of occupation, B = Bird but no nest, C = Pair but no nest, D = Nest but no eggs, E = Nest with eggs, F = Nest with young, G = Large young probably fledged or fledged, H = Site not checked. Potential future sites are sites where the BTO has no evidence of prior breeding.

	Status Codes	2002 National Survey	SWPMG database
Breeding	E F G	50	59
Probably Breeding	C D	16 *	17
Potential Future Site	(C)	1	0
Single Bird	B	7	4
Unoccupied	A	11	13
Not Checked	H	6 **	4
TOTALS		91	97

Data collected by the SWPMG in 2002 was passed to the 2002 National Survey co-ordinators, so the 7% difference between our cumulative dataset and the BTO National Survey database needs to be explained. Firstly, there were six sites not on the BTO National Survey database: one was a long-deserted site that was not occupied in 2002 (Table 3, Row #1), three were not checked by us until later in the year of 2002 or in 2003 (Rows #2 and 3), one was a site, occupied during the 1991 National Survey and also occupied in 2002 but which did not appear on the BTO database in 2002 (Row #4) and one was a long-deserted site not visited by us in 2002 (Row #5). All the other territories were on the BTO database but the status of the territories were recorded incorrectly.

There were eight sites where the status code assigned to the territory by the SWPMG and the BTO significantly differed and of these seven were elevated from 'Potential Future Site', 'Not Visited (H)' or 'Occupied by Single Bird (B)' to 'Occupied by Pairs

(C)' or 'Confirmed Breeding (D, E or G)' status. These comprise one site recorded as a singleton but from which one chick fledged (Row #6), two sites recorded as occupied by singletons that were actually occupied by pairs (Row #7), one site not known to us in 2002 but visited in 2004 when we found pigeon rings indicating long-standing, regular occupancy since the mid-1980's (Row #8), and one long-standing site where we observed a bird incubating in 2002 (Row #9) and one site recorded as occupied by a singleton that was occupied by a pair with a nest scrape (Row #10). In addition another site regarded as a 'potential future site' in the 2002 National Survey database was a breeding site where we recorded a bird incubating (Row #11). These differences resulted in an additional seven territories being recorded as 'breeding' or 'probably breeding' in the SWPMG database. The other differences were not so important in that they did not alter the final estimate of the number of territorial pairs, but they included one site where we thought the territory was unoccupied but subsequently discovered in 2003 that the pair had shifted to an adjacent quarry that was not checked in 2002 (Row #12).

Table 3. Differences in territory coding between the 2002 National Survey database and the database of breeding territories compiled by the SWPMG.
See legend for Table 2 for an explanation of the territory codes.

Row ID	BTO code	SWPMG code	No. of sites
#1	Unknown	A	1
#2	Unknown	C	2
#3	Unknown	D	1
#4	Unknown	E	1
#5	Unknown	H	1
#6	B	G	1
#7	B	C	2
#8	H	C	1
#9	H	E	1
#10	B	D	1
#11	Potental Future Site	E	1
#12	A	H	1

The BTO results reported 105 inland pairs in South Wales during 2002 (Table 1), of which 64 were in our south-central Wales study area (i.e., excluding 7 coastal sites), therefore, according to the BTO National Survey data, only 41 additional pairs bred in inland South Wales outside our study area. However, the RSPB county totals for inland South Wales outside our study area was at least 50; comprising 15 in Radnor, 6 in Pembroke, 15 in Cardigan, 8 in Carmarthen, 3 in Monmouth and 3 in Glamorgan. This does not include any Peregrines in Montgomery, which held 23 pairs, some of which would have undoubtedly bred in the part of the county designated by the BTO as South Wales. We are aware of at least a further eight regular breeding territories in the South Wales region of Montgomery, giving a minimum total of 58 occupied territories outside our south-central Wales study area in inland South Wales. Consequently, the 2002 National Survey has under-estimated the number of occupied territories in this region by at least 29% (41 *cf.* 58 pairs).

DISCUSSION

The 2002 National Survey results for Wales published by the WRSG and the BTO differ by 10% (321 *cf.* 288 pairs). The WRSG's total included additional data that was not included in the BTO's results. The WRSG obtained additional records from the SWPMG, CCW licence returns and other sources. Direct comparison of the BTO 2002 National Survey data with our own database showed that within our south-central Wales study area the National Survey results underestimated the number of Peregrine pairs by nearly 7% (71 *cf.* 79 pairs). Furthermore, when we compare the datasets of the WRSG and BTO for the rest of inland South Wales outside our study area, the National Survey underestimates the number of Peregrine pairs by at least 29% (41 *cf.* 58 pairs). We say "at least 29%" because it is likely that more than eight of the 23 pairs recorded breeding in Montgomery would have bred in the BTO region of inland South Wales. Furthermore, if the National Survey results under-recorded the number of pairs in our intensively studied area by 7% it is possible that the WRSG estimate of at least 58 pairs in the region outside is itself likely to be an under-estimate.

At the end of the 2002 we had been annually surveying Peregrines in our south-central Wales study area for 3 years and had been monitoring nests across much of this area for many more years. We thought that we had found all the pairs in this area. However, it turns out that we had missed five occupied breeding sites in 2002. Clearly, breeding Peregrines are not as easy to survey as might be assumed, particularly now that the population in Wales has increased making the location of every pair in a survey area a demanding task. Certainly, the discrepancy between the published survey results of the RSPB/WRSG and BTO has become greater with increasing population size, as the discrepancy was only 6% in 1991 and had risen to 10% in 2002.

A possible explanation for some of the difference in the National Survey results presented by the WRSG and the BTO is that the criteria adopted by these organisations for regarding a site as occupied may have differed. If a site was found to have been occupied but there was no proof of breeding, nor any prior proof of breeding, it was not included in the totals compiled by the BTO (H. Crick *pers. comm.*). Such sites were recorded by the BTO as 'potential future sites' and the occupants as 'prospecting birds', whereas the WRSG simply recorded such sites as 'occupied'. The mechanism for assessing the past breeding status of 'potential future sites' relies upon records being made available to the BTO by individual raptor workers, but in counties where there is little annual systematic survey of Peregrines there will be less information available to make such an assessment. Consequently, some counties may have a disproportionate number of actual breeding territories classified merely as 'potential future sites' than others. This demonstrates how regional variation in survey effort by raptor workers between national survey years could influence the outcome of the national survey results.

Our study clearly shows that the 2002 National Survey results for inland areas of South Wales are inaccurate. It appears that this inaccuracy results from several factors. Firstly, some Peregrine breeding sites are simply overlooked; pairs occupied at least five of the six sites in south-central Wales that were not recorded in the National Survey database in 2002. Secondly, some sites are recorded as occupied by singletons when in fact pairs occupy them; it is very difficult to be sure that only one Peregrine is occupying a site. With a surfeit of non-breeding Peregrines and a stable breeding

population in south-central Wales (see Dixon *et al.*, 2006) territory occupancy by single birds is, in our opinion, unusual. Thirdly, with an increasingly large database errors in the recording, collation and analysis of this information are more likely; for example the Banks *et al.* (2003) report erroneously recorded that there were no known territories in Wales that were not visited in 2002, whereas there were at least six such sites listed in the BTO database for our south-central Wales study area alone.

It seems likely from comparison of the published RSPB, WRSG and BTO data (Table 1), that there has also been significant under-recording in North Wales, which could be as high, or even higher, than that found in South Wales with *ca.* 106 inland sites recorded by WRSG (including 15 in Montgomery) *cf.* 93 recorded by BTO (i.e., 12% under-recording). Certainly, this degree of under-recording undermines the validity of statements reporting a significant population decline in North Wales (Crick *et al.*, 2003), which in itself conflicts with a reported population increase in north-east Wales (Roberts & Jones, 2004). Roberts & Jones (2004) reported that the 2002 National Survey only recorded 41% of the territorial Peregrines within their 100 km^2 study area. We suggest that future National Peregrine Surveys should include a random squares survey in addition to the current methodology (i.e., an absolute count with a correction factor for unvisited known sites) in order to obtain confidence intervals for the population estimates.

ACKNOWLEDGEMENTS

We wish to thank Graham Williams for persevering with us in our quest for data and especially we wish to thank Reg Thorpe and Andy Young of the WRSG for supplying data from their files and Humphrey Crick of the BTO for supplying the 2002 National Survey data for our study area. We wish to express our gratitude to Derek Ratcliffe, who sadly died during the preparation of this paper, for his interest in and contributions to the work of the SWPMG; his enthusiasm, knowledge and expertise was an inspiration to us.

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WELSH BIRDS AND CLIMATE CHANGE

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SUMMARY

As climate change continues we should expect to see further changes, be they slow or dramatic, in our Welsh bird populations. This paper survey discusses changes that have occurred to Welsh birds over the last 20 years that seem to be linked to climate change, in a similar fashion to UK changes that have been analysed by the BTO (Leech). Originally this work was produced for an educational web site (Climate Change Wales). Data has been extracted from Birds in Wales, Birds in Wales 1992-2000, Welsh Bird and Pembrokeshire Bird Reports as well as various web sites.

Many resident species appear to be doing well as a result of reduced winter mortality, earlier breeding and increased breeding performance. Indeed the "milder" Welsh climate has allowed two species to recently colonise the Principality.

Climate change will have a greater effect on migratory species. Already several species have changed their behaviour, migrating to Wales to breed earlier in the year and departing sooner, while some winter visitors are arriving later in autumn and departing for their northern breeding grounds earlier in the spring. The timing of their arrival is important in relation to the quantity of their food and this lost of synchronisation does appear to have a negative effect on some species. These changes are complex and are not fully understood as yet. As the effects of Climate Change are expected to escalate one can only guess at what changes are to come.

INTRODUCTION

There is much talk in newspapers, magazines and in the field about Global Warming. Mean global temperatures are currently 0.4-0.8°C higher than they were in the late 1800s (Houghton *et al.*, 2001) and are expected to continue to rise during this century as the atmospheric concentration of carbon dioxide continues to increase. Nakicenovic & Swart (2001) in a report published by the Intergovernmental Panel for Climate Change (IPCC) predicted an increase in mean global temperatures of 0.6-2.4°C between 2000 and 2050, and an increase of 1.2-5.6°C by 2100 (summarised in McCarthy *et al.*, 2001). Here in Wales, it is predicted that by 2080 it will be, on average 1.1° C to 2.9° C warmer than at present (Welsh Assembly Government website) and apart from a warmer climate it could mean:

- more frequent storms
- a rise in sea level
- increased rainfall and greater inflow to estuaries and the sea
- changes of rainfall pattern during the year - wetter winters and drier summers
- increased evapo-transpiration
- changes in the direction and strength of prevailing winds

Additionally we all have anecdotal evidence of changes in bird populations, arrival times and the like. We have all heard and even said: "ten years ago there were ...". Indeed recent estimates of European bird populations have suggested that 71% of bird species have changed since 1900 and that 44% of them may be due to climate change. Tables 1-3 gives the percentage change of Welsh bird populations, as derived from CBC/BBS data 1994 – 2005. As one would expect, no population is always constant and those with small changes (up to 10% either way) are probably normal. It must also be noted that these are estimates from a reasonably large sample size and are therefore probably a fair reflection of what is going on in Wales (there may be other species whose populations have also changed over the last 20 years, for which there are not enough comparable data in Wales.

Table 1. Population changes for Resident species in Wales that appear to be declining – percentage change, as derived from CBC/BBS 1994 – 2006.

Residents	Percentage change 1994-2006	Residents	Percentage change 1994-2006
Heron	-18	Rook	-24
Buzzard	-5	Starling	-51
Curlew	-40	Chaffinch	-6
Skylark	-2	Linnet	-7
Goldcrest	-40	Bullfinch	-42
Coal Tit	-28	Yellowhammer	-44
Magpie	-8		

Table 2. Population changes for Resident species in Wales that appear to be increasing – percentage change, as derived from CBC/BBS 1994 – 2006.

Residents	Percentage change 1994-2006	Residents	Percentage change 1994-2006
Mallard	23	Mistle Thrush	2
Pheasant	45	Long-tailed Tit	33
Wood Pigeon	31	Blue Tit	32
Collared Dove	33	Great Tit	55
Green Woodpecker	11	Nuthatch	51
Great S. Woodpecker	82	Treecreeper	40
Meadow Pipit	3	Jay	33
Pied Wagtail	13	Jackdaw	19
Wren	3	Carrion Crow	30
Dunnock	38	Raven	13
Robin	13	House Sparrow	107
Stonechat	287	Greenfinch	26
Blackbird	39	Goldfinch	25
Song Thrush	31		

Table 3. Population changes of Summer visitors in Wales – percentage change, as derived from CBC/BBS 1994 – 2006.

Summer Visitors	Percentage change 1994-2006	Summer Visitors	Percentage change 1994-2006
Cuckoo	-36	Swallow	73
Swift	-31	House Martin	95
Tree Pipit	-28	Wheatear	10
Redstart	-2	Blackcap	77
Garden Warbler	-24	Chiffchaff	1
Whitethroat	-9		
Willow Warbler	-22		

The difficulty in selecting suitable examples to study is that many populations have changed due to habitat change, persecution and agricultural changes & practices. Species such as Yellowhammer, Tree Sparrow, Skylark and our Red Kite fall into these categories and although climate change may be having some form of impact, it is not the main reason for their decline or rise. It must be noted that relationships between climate change and certain species are essentially correlations and therefore do not necessarily imply cause. But where there is no other obvious other reason for their change, climate change does appear to be a fairly plausible explanation.

The effects of climate change on birds vary depending on whether the birds are resident, whether they come here in the summer to breed or if they winter in Wales. Therefore, species have been divided into four broad categories: Residents, Summer visitors, Winter visitors and Losses and Gains

Residents

Resident birds, those that are with us all year round, have to endure the cold of our winters and with that comes higher mortality rates. Climate change, bringing milder winters and shorter periods of frost should, in theory, mean reduced winter mortality and a consequent increase in the breeding population. Tables 1 & 2 above, show that many of our resident species are undergoing population changes. It has been suggested that most of these changes are linked to climate change, be it reduced winter mortality, better weather during the breeding periods or changes in breeding behaviour (Leech).

Reduced Winter Mortality

Stonechat, a bird of heath and uplands, is one species which provides evidence of the effect of milder winters causing reduced winter mortality and a subsequent increase in the breeding population. Table 4 clearly shows that the numbers of Stonechats in several Welsh counties (those with comparable data sets) have increased in the last 30 years. Indeed the total Welsh population was estimated at 420 pairs in 1968 but by the turn of the millennium it had risen to between 3,000 and 3,500 pairs. More recent figures from BBS suggest that this population increase has continued at an even faster rate (a change of 287% between 1994 and 2006).

Figure 1 above shows how the UK population of Stonechat has increased over the past ten years. The dips in 1996 and 1997 coincided with and presumably were caused by cold winters. The preferred habitat hasn't changed, just a reduced winter mortality

which had lead to a greater breeding population and subsequent colonisation of inland heaths.

Synchronisation with food abundance

Climate change has another effect, this time in the spring and summer – the breeding season. A warmer climate will cause an earlier spring flush of leaves on the trees (leaf emergence has advanced by an average of 6 days in Europe between 1959 and 1993, Walther et al 2002), which in turn will lead to an earlier food resource for the many invertebrates which feed on the leaves, so they in turn will emerge earlier each spring. Indeed research into the oak winter moth has shown that it takes on average 50 days for their caterpillars to emerge at field temperatures but only 20 days if kept at a constant 15°c (Leech). For any species to survive and breed successfully it must adapt to its environment. The timing of egg-laying is critical, so that the eggs hatch at peak food abundance. The BTO have analysed the results of the Nesting Bird Survey (Crick – BTO website) and have found that many resident birds in the UK are laying their eggs earlier each spring (Table 5), presumably to take into account this shift of food supply caused by climate change. An analysis by Crick and Sparks (1999), again using BTO Nest Record Scheme data, revealed that laying date was significantly related to temperature or rainfall trends for 31 of the 36 species examined over a 57 year period, with 53% of these species exhibiting a significant trend towards an advancement of laying dates. The laying date advancement of 37% of these species could be explained by climatic trends. Furthermore, the authors calculated that, based on current predictions of trends in climatic temperature over the current century, 75% of the 36 species will have advanced their laying dates by 2080.

Table 4. Welsh Stonechat censuses 1968 and 2000 (Lovegrove *et al.* 1994).

County	1968	2000
Carmarthenshire	2	42
Brecon	5	22
Denbigh	1	14
Glamorgan	59	120
Montgomery	1	8

Fig. 1. Changes in UK Stonechat population, 1994-2005 (BTO website)

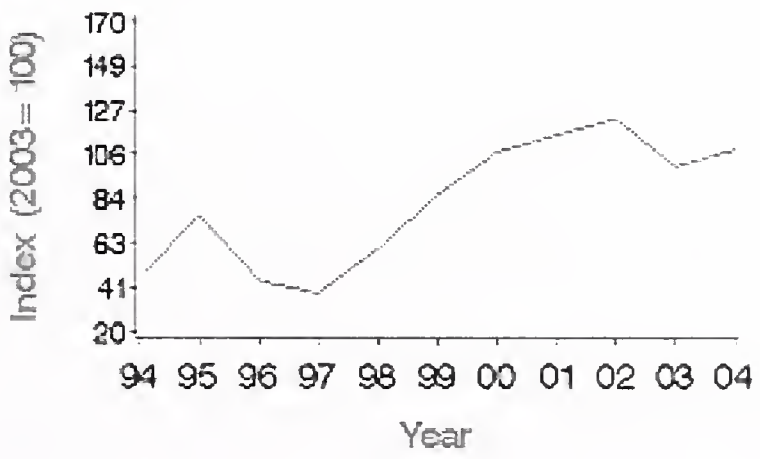


Table 5. Percentage Welsh Population Change from CBC/BBS 1994-2006 along with trends in egg-laying date. A positive figure means the number of days later the 1st egg is laid in 2003 when compared to 1968, while a minus means the number of days earlier the 1st egg is laid in 2003 compared to 1968. The * signifies a small sample size. Data from BTO Nest Recording Scheme, arranged by change in egg-laying.

Species	Percentage Welsh Population Change 1994-2006	Change in 1st egg-laying date 1968 – 2003	Species	Percentage Welsh Population Change 1994-2006	Change in 1st egg-laying date 1968 – 2003
Magpie	-8	-29	Blue Tit	32	-7
Grey Heron	-18	-28	Great Tit	55	-7
Long-tailed Tit	33	-16	Meadow Pipit	3	-6
Greenfinch	26	-13	Robin	13	-6
Nuthatch	51	-11 *	Wren	3	-5
Carrion Crow	30	-11	Stonechat	287	-5
Chaffinch	-6	-9	Jackdaw	19	-4 *
Oystercatcher		-8	Lesser Redpoll		-2 *
Dipper		-8	Skylark	-2	4 *
Marsh Tit		-8 *	Yellowhammer	-44	5 *
Treecreeper	40	-8 *	Stock Dove		13 *
House Sparrow	107	-8			

The BTO has discovered that Great Tits on average lay their eggs seven days earlier now than in 1968. This re-alignment with the peak emergence of caterpillars as well as reduced winter mortality has resulted in the Great Tit's population in Wales increasing considerably - a 55% increase in the period 1994 – 2006 (Figure 2).

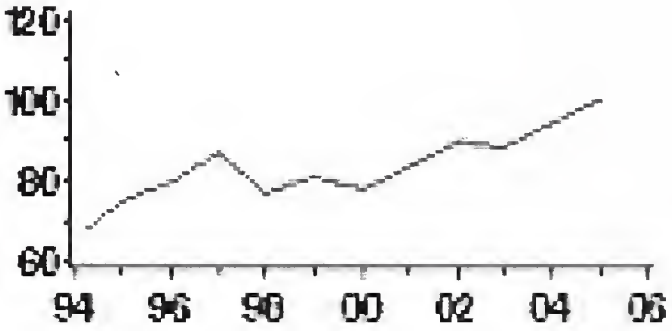


Figure 2. Increasing Welsh Great Tit population (1994 – 2005)
(BTO website).

Similar changes to those of Great Tits in starting to breed earlier in the year can be seen in species such as Greenfinches and Long-tailed Tits, both presumably reflecting the better conditions and a shift in food availability. In 2004 Greenfinches laid their eggs nearly two weeks earlier than in 1968, a pattern that has been steadily changing over the last 35 years.By reproducing earlier, the young of the first brood have longer to put on weight ready for the winter and are therefore less likely to die during the winter period and will be able to start breeding earlier in the following spring. On a negative note, research suggests that another modification to combat earlier "springs" and therefore breeding seasons is for birds to lay fewer eggs (Leech).

Oceanic species

The effects of climate change have not only been observed with land birds; a similar picture is emerging for those that spend most of their life at sea but come to Welsh cliffs and islands to breed. Slight variations in oceanic currents, due to climatic warming (surface temperatures of the SW Atlantic & Irish Sea have increased by 0.6°c in the last 20 years), may have major consequences for fish populations in the Irish Sea and the Atlantic. These in turn would affect the abundance and distribution of seabirds.

In the North Sea there are many accounts documenting the disastrous effects of global warming, with many species failing to breed. The increased water temperatures and over-fishing have reduced fish stocks (particularly Sand Eels) leading to many seabirds failing, year on year, to breed successfully. The story is different in Wales, where over-fishing has not been a major issue and the sea-bird populations have increased over the last 20 years. It has been suggested that the warmer water, coming up from the Bay of Biscay, is being mixed with nutrient rich water from further out in the Atlantic, leading to improved growing conditions for algae and plankton, which in turn is powering a more productive food chain. Research has shown greater populations of phytoplankton, sprats, anchovies and sardines (RB Wynn pers comm.). So Climate change is impacting on the bottom end of the food chain.

Leech uses the increasing Fulmar population as an example of how climate change has affected one oceanic species but other authors (in Brown & Grice) put this down to other factors including hydrography. Fulmars (once restricted to just St. Kilda in Scotland) started expanding in the mid 1800's and it was first recorded breeding in Wales in 1941. By 1987 the UK Seabird Register reported 2,472 nesting Fulmars in Wales, 1,409 of which were in Pembrokeshire, 318 in Ceredigion, 400 in Caernarfon and 300 on Anglesey. The Welsh Fulmar population has increased since then and appears to have reached a peak (presumably related to the number of possible nesting ledges), with 2,591 nests recorded in Pembrokeshire in 1997.

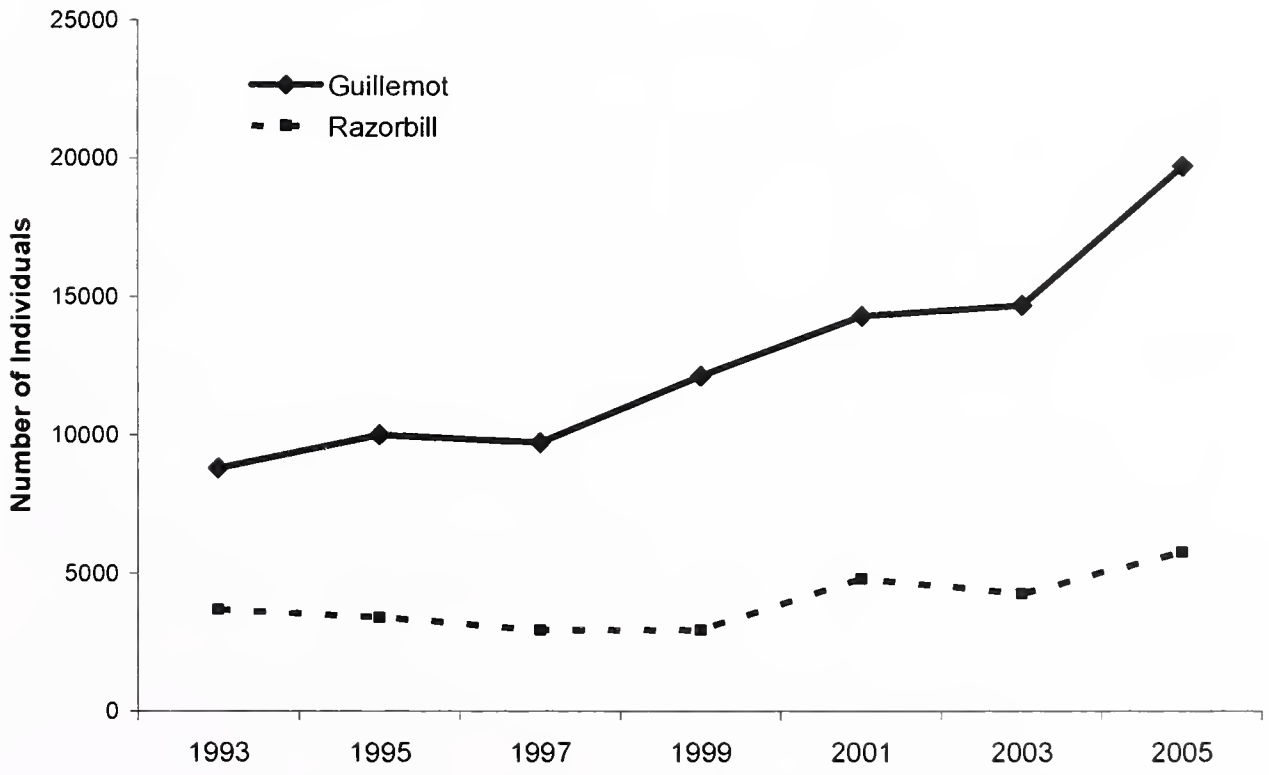


Figure 3. Numbers of Breeding Auks on Skomer

Other seabird species such as the auks (Guillemot and Razorbill) are also increasing in Wales. Figure 3 charts the changes in numbers of individual seabirds on Skomer Island, Pembrokeshire in spring over the last 12 years. Razorbills have increased slightly but Guillemots have increased to unprecedented levels. In contrast, the Puffin, a similar species, has declined then recovered to about the same level in 2005 as it was in 1995 (this may be linked to burrow availability limiting any population growth and the decline following the Sea Empress disaster in February 1996). There have been significant increases elsewhere in Wales. On Bardsey, Caernarfon, Guillemots have increased from the 20 pairs in 1901 to around 4-500 individuals from 2000-2006 and the number of Razorbills have doubled from the 250 there in 1993 to 2,000 in 2006. Likewise on South Stack, Anglesey the number of Guillemot has increased from 1,363 in 1976 to around the 3,000 mark 1992-2006 (Green 2002 and Welsh Bird Reports).

Another species that has increased is Gannet. The third largest gannetry in the world is on the island of Grassholm, off the coast of Pembrokeshire. The colony was established in 1820 and has steadily grown over the last 200 years so that the majority of the island is now covered with nests. Indeed, to the casual observer the island appears white – not snow or the colour of the rocks, but Gannets. In 1903 there were 250 pairs on Grassholm and this has steadily risen to 4,780 in 1933, 15,500 in 1964, 28,535 in 1984 and to 32,194 in 2004 (Green 2002 & Pembrokeshire Bird Reports).

Kittiwakes however do not show any overall pattern. It has been suggested that an increase in westerly winds, stirring up a greater food source should result in an increase in Kittiwake numbers (Leech). Data from south Wales does not show any such pattern, indeed this species appears to be stable on Skomer, at around 2,000 – 2,300 pairs but decreasing dramatically along the Pembrokeshire coast.

Overall our seabirds seem to be doing well and increasing, particularly Guillemots and Gannets, both presumably benefiting from increased food resources in the SW approaches and Irish Sea.

Summer visitors

Most summer migrants start arriving in Wales half way through April onwards, having spent their winter in Africa. Time is of the essence. Not only must they breed but they must have time to put on weight ready for the return migration which may begin in August. These summer migrants may be affected by climate change in more than one way.

- Warmer summer temperatures should in theory improve food supplies and therefore breeding performance.
- Drier conditions in their wintering quarters (as a result of global warming and desertification) may mean reduced winter survival.
- Longer migrations, due to having to winter further south. This in turn means that there is the requirement to have greater fat reserves to survive the longer flight or that birds arriving in Wales are under-weight (this may lead to increased mortality).
- Reduced feeding opportunities on the journey due to a lack of suitable feeding sites.
- Earlier arrival times, attempting to re-synchronise with their traditional food source

Table 6. Comparison of population changes, arrival dates and egg-laying of summer visitors in Wales. Blanks refer to a lack of data. A minus figure in the last two columns indicates earlier, while a positive value means later. There are no Welsh Percentage Change figures for Sand Martin, Whinchat, Grasshopper and Sedge Warbler, so UK figures have been substituted in this table (indicated by italics).

	Welsh Percentage change 1994-2006	Arrival dates in Pembrokeshire (1981 – 2005)	Change in the Mean earliest UK Egg-laying (1968-2003)
Declining species			
Cuckoo	-36	+2	
Swift	-31	-4	
Tree Pipit	-28	-11	-9
Redstart	-2	-2	-10
Whinchat	*-22*	-2	-4
Garden Warbler	-24		-7
Whitethroat	-9	-2	-6
Willow Warbler	-22	-19	-7
Increasing species			
Swallow	73	-1	-7
House Martin	95	+ 15	
Wheatear	10	-29	
Blackcap	77		-12
Chiffchaff	1		-14
Sand Martin	*115*	-7	+ 18
Grasshopper Warbler	*49*	-7	
Sedge Warbler	*0*	-3	

Overall, according to these figures, the number of increasing migrants is approximately equal to the number of decreasing ones. It would appear that all species are breeding earlier now than they did thirty five years ago (the only exception is Sand Martin, whose figures may be distorted by a small sample size), presumably as a response to earlier emergence of prey species (as discussed in the residents section). In relation to migration times, virtually all species are arriving back in Pembrokeshire at least, earlier now than they did 25 years ago (with the exceptions of Cuckoo and House Martin) presumably so that they can get on with breeding earlier in the year. Apart from this, there is no overall correlation between percentage population change, arrival dates and mean egg-laying – each species is changing in different ways. Those that are declining appear to be arriving much earlier and breeding much earlier but are suffering presumably as they have not been able to adjust their balance between arriving and breeding earlier - perhaps due to being under-weight or from poor feather condition. While those that are increasing, must have discovered a more favourable balance between arriving and breeding earlier. Recently researchers have started to notice that migrants are laying smaller clutches of eggs (in both Crick and Leech) as an additional response to arrival and breeding earlier in the spring / summer. There is still much to be understood.

Anomalies include:

- Sand Martin, which is arriving much earlier now than they used to do but appears to have delayed its breeding by nearly three weeks (although this is a small sample size – and therefore may not be a true reflection of the whole population).
- Willow Warbler which are arriving three to four weeks earlier in Pembrokeshire than they used to yet their populations are declining dramatically. It must be noted however that these are passage migrants on their way to breed further north (ringing recoveries from Bardsey suggest that they are Scottish breeders [S.D. Stansfield pers com.]) and therefore may not reflect local breeding birds.
- House Martins are arriving significantly later than they do 25 years ago, yet are increasing dramatically. The later arrival and presumably later breeding must be beneficial in some way. Is it in relation to nest building, insect availability or some other factor ?
- Cuckoos are arriving fractionally later but are declining – this is probably due to asynchronisation with their parasitic host (see later).
- Whinchats are similarly arriving fractionally later but are declining – probably due to inter-specific competition (see later).

Pied Flycatcher is another species that has declined in Wales and one for which there isn't comparable data on arrival times or egg-laying. However there is data for certain Welsh sites, such as the RSPB reserves of Dinas and Gwenffrwd, in Carmarthenshire, where there is an excess of available nest boxes and counts of occupied boxes and ringing studies have logged the number of young fledged (Figure 4).

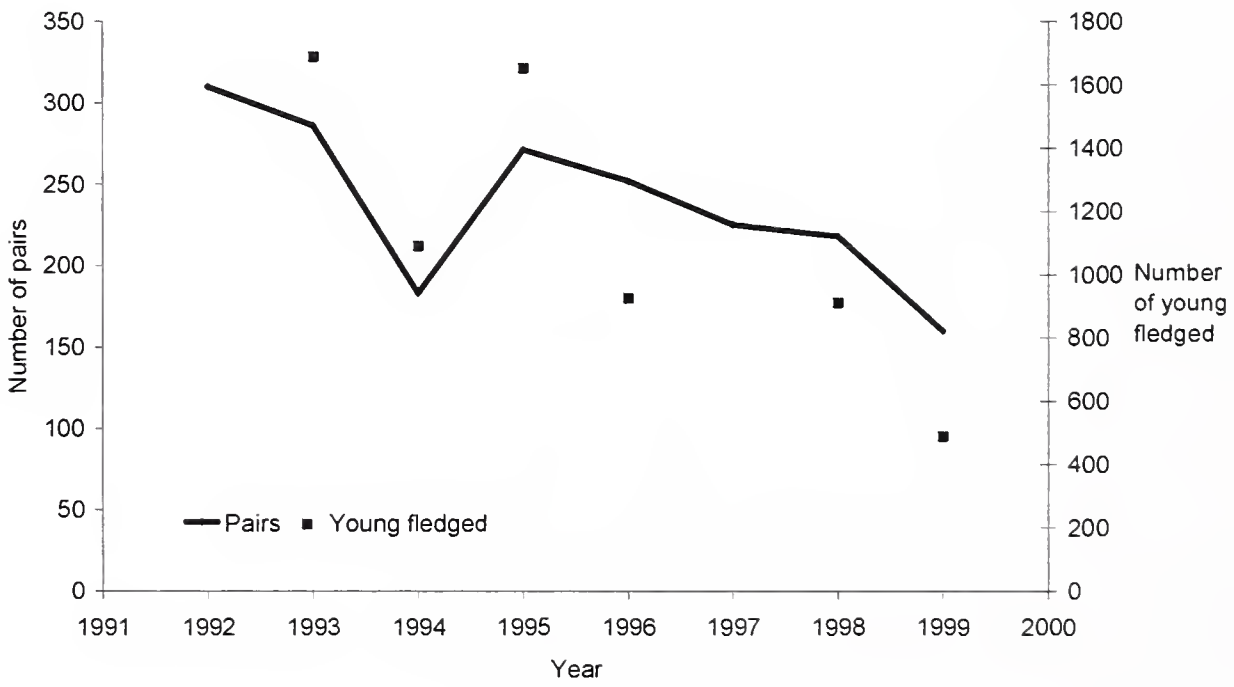


Figure 4. Number of pairs of Pied Flycatchers and number of young fledged at RSPB Dinas and Gwenffrwd 1991-1999
(more recent data is not available from this site).

Data from England (Leech) suggests that Pied Flycatchers are not arriving on their breeding grounds any earlier than in the past and that their mean egg-laying date has been brought forward by 10 days. This is presumably an attempt to re-synchronise with food availability.

Figure 5. Changes in the UK Pied Flycatcher Population, 1994-2005 (BTO data)

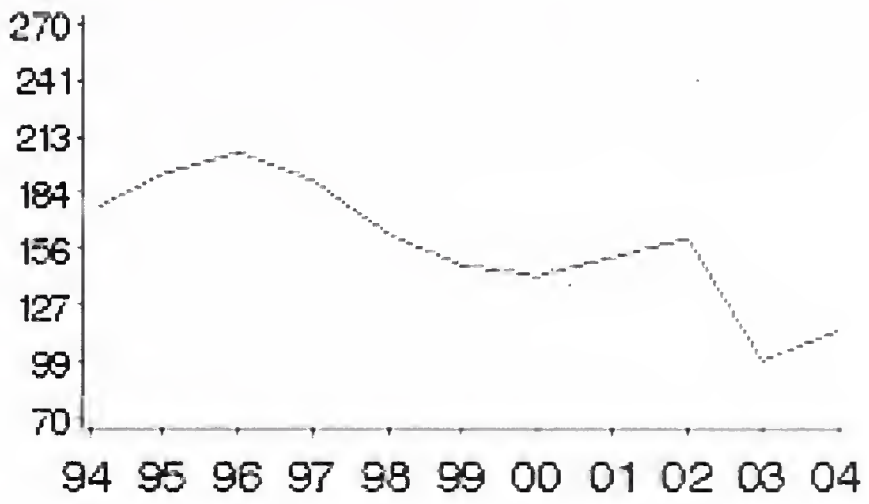
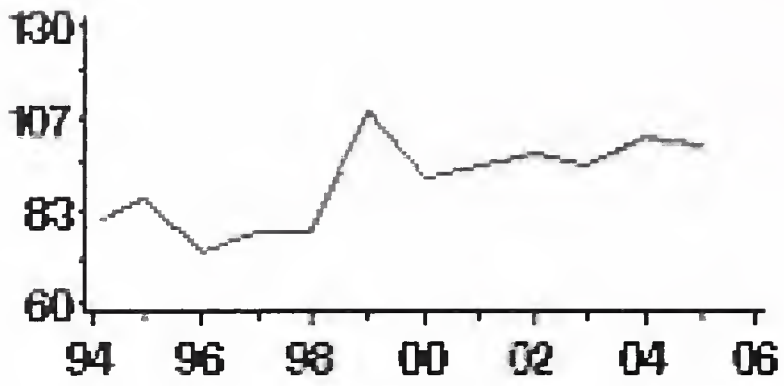


Figure 4 and Figure 5 show a similar depressing trend – reduced number of pairs and poor productivity leading to a significant population decline.

This shorter period between arrival and egg-laying means that there is less time for the energy-starved migrant to feed up before starting to breed and therefore parents are not in optimum condition, this leading to increased adult mortality and decreased breeding success. Add onto this the more recent trend of wetter springs then it is not so surprising that Pied Flycatchers in Wales are having a hard time.

Further evidence of asynchrony between offspring production and prey availability can be shown with the Cuckoo. Cuckoos winter in Africa and are therefore being subjected to the changing climate in their wintering grounds. Table 6 shows that in Pembrokeshire, at least, there has not been any real change over the last 25 years. The Cuckoo population has been declining throughout Wales for the last 50+ years. The Welsh population was estimated in 1986 at 1,800 pairs, but by the turn of the century it had decreased to 1,200 pairs. Studies by the BTO suggest that the population has decreased by 32% during the period 1994-2005. In recent years the species has disappeared from large areas of Wales, although present in each county, its distribution has changed and is now restricted to the uplands.

It is postulated that Meadow Pipits, a resident species, has responded to climate change, firstly in reduced winter mortality and secondly by starting to breed earlier in the spring. Meadow Pipits are on average laying their eggs 6 days earlier in 2003 compared to 1968. This would mean that by the time Cuckoos arrive in Wales, their host species are further into their breeding cycle, therefore there will be fewer potential hosts nests in which to lay their eggs. This could be resulting in reduced breeding performance and at least partly explain the population decline.



The Cuckoo's breeding habitats are generally unchanged in Wales, whereas their main parasitic host species, the Meadow Pipit, is increasing (Figure 6).

Figure 6. Changes in the Welsh Meadow pipit population 1994-2005 (BTO)

Yet another effect of Climate Change is increased competition. Whinchats and Stonechats are closely related species, with heathland being their preferred habitat. Stonechats are resident species and their populations have increased dramatically with the milder winters leading to reduced mortality, increased breeding population and subsequent colonisation of upland heath (a habitat which traditionally would have been inhospitable to them due to harsher winters). Whinchats however are summer visitors, wintering in Africa and are therefore experiencing the effects of climate change there. Not only that but on arriving at their traditional breeding grounds in Wales' upland heath (only marginally earlier than in the past, Table 6), they find that Stonechats have already moved in – their habitat is already occupied. Although there is no direct evidence of Whinchat / Stonechat battles, inter-specific competition is thought to be having a significant effect. So this species has been affected by climate change at both ends of its migratory lifestyle.

Winter visitors

Many species come to Wales in autumn, spending their winter here before returning to their breeding grounds in the spring. By doing this they avoid the harsh weather, lack of food and high mortality that winter brings to these northern climes. Although climate change is a global phenomenon, winter temperatures in northern Europe and Scandinavia are still unfavourable for these species.

Table 7. Five-year Mean Last spring departure and First autumn arrival dates for Fieldfare & Redwing in Pembrokeshire 1986 – 2005.

	Five-year Mean Last Spring Departure Date			
	1986-1990	1991-1995	1996-2000	2000-2005
Fieldfare	Apr. 27th	Apr. 24th	Apr. 13th	Apr. 12th
Redwing	Apr. 24th	Apr. 12th	Apr. 18th	Apr. 15th

	Five-year Mean First Autumn Arrival Date			
	1986-1990	1991-1995	1996-2000	2000-2005
Fieldfare	Sept. 29th	Oct. 8th	Oct. 10th	Oct. 5th
Redwing	Sept. 27th	Oct. 4th	Oct. 4th	Oct. 5th

As the UK is experiencing milder winters, greater numbers are likely to remain in northern Britain and fewer should be seen here in Wales. Species such as Redwing and Fieldfare are nomadic in nature, constantly on the move depending on the availability of berries and therefore keeping tabs on the numbers wintering in Wales is impossible. They start arriving in Wales mid to late October and remain here until March and April.

Table 7 clearly shows that both Fieldfares and Redwings are departing for their breeding grounds earlier in the year (by nearly two weeks in the case of the former and by more than a week in the case of the latter) and arriving back in autumn a week later in the last five years compared to 20 years ago. The recent changes in winter climate have instigated earlier northward migration and the warmer autumns in Scandinavia are causing birds to defer their southward trip.

Many species of ducks and waders breed on the Arctic Tundra where 24 hours of summer daylight provides plenty of food for their chicks. As the seasons change they migrate south west to spend their winters on Welsh estuaries. As Wales has a milder, maritime climate, they can survive the winter and importantly feed in a frost-free environment. Thousands of ducks (such as Wigeon, Teal and Pintail) and waders (such as Redshank, Dunlin and Curlew) winter on Welsh Estuaries, the most important of which are (from south to north) the Burry Inlet (Carmarthenshire / Glamorgan), the Cleddau (Pembrokeshire), the Dyfi in Ceredigion / Meirionnydd, Traeth Lafan (Caernarfon / Anglesey) and the Dee (Flintshire and Cheshire). All these sites are either Nationally (containing 1% of the UK wintering population) or Internationally Important (containing 1% of the world wintering population) for certain species. Five-year Mean Peak Winter (November – February) counts are shown in Table 8.

Table 8. Mean Five-year winter peak (November – February) counts of wintering ducks and waders on the larger Welsh estuaries.

	1986-1990	*1996-2000*	*2001-2005*	*Comment*
Wigeon				
Burry	5098	3033	2175	Declining
Cleddau	3951	3481	5006	Increasing
Dyfi	4042	3469	2042	Declining
Dee	2123	3458	4266	Increasing
Teal				
Burry	1082	1569	1029	Stable
Cleddau	2673	3481	5006	Increasing
Dee	5359	5840	4425	Declining
Pintail				
Burry	1878	4290	3112	Increased, then declining
Dee	7205	4691	5066	Declining
Redshank				
Burry Inlet	1063	975	224	Declining
Cleddau	1442	638	531	Declining
T. Lafan	589	522	1423	Increasing
Dee	7551	5190	5983	Declining

Curlew				
Burry Inlet	1441	1120	1013	Declining
Cleddau	1832	1324	853	Declining
T. Lafan	1375	1252	1767	Increasing
Dee	3483	4271	3934	Increased, then declining
Dunlin				
Burry Inlet	1444	1334	1011	Declining
Cleddau	3743	5832	2134	Declining
T. Lafan	4718	2613	4540	Declined, then increased
Dee	15100	27937	30802	Increasing

The act of migration to and from the tundra uses up large amounts of fuel and these migrants need to put on a lot of fat before they start to migrate (in late summer and again in late winter before they go back) to fuel their long distance journey. As the climate is warming they shouldn't have to migrate as far to find the perfect wintering grounds and therefore we would expect to see declining wintering populations. However there are no overall trends that can be deduced from this data, with no species declining in all of the main Welsh sites. Perhaps the increases in certain species & sites are down to birds that traditionally wintered in Ireland and SW England that are now wintering in Wales instead. As with the Welsh sea-birds, much is still not understood.

The milder winters have not, so far, caused any species not to winter in Wales but a few species are visiting here more regularly these days than they have in the past. Traditional summer migrants such as Blackcaps and Chiffchaffs are wintering in Wales in greater numbers today than they have in the past, yet initial results from ringing studies suggest that they are continental birds not our own.

Loss and gain of species

A few migratory species are undeniably in trouble in Wales, such as Turtle Doves and Yellow Wagtail (although other factors such as hunting, agriculture and land drainage have undoubtedly had a major impact). Other species appear to be increasing – those that were traditionally at the northern limit of their range in the UK, such as Honey Buzzard (at least 10 pairs now breed in Wales) and Hobby (now breeding in several Welsh counties). Thomas & Lennon (1999) quote that over the period 1972-1991, British bird species extended their breeding ranges north by an average of 18.9km in response to increasing mean annual temperatures at the northern extent of their distribution. Two species have begun to colonise Wales, the Little Egret and the Dartford Warbler, while Mediterranean Gulls and Mediterranean Shearwaters are being seen more regularly in Wales these days than they have in the past.

The Little Egret, once a National Rarity in Wales (up to 1991 there had only ever been 78 recorded individuals in Wales), expanded its range into northern France (during the 1980's) and then into the SW of Britain. Annual autumn influxes started occurring in in Wales from 1993 onwards, when 66 were recorded, 101 in 1994, 123 in 1995 and by 1996 there were so many being recorded in Wales it was impossible to determine how many birds were involved. As time progressed many started to summer and in 2001 the first confirmed breeding took place in Gwent. In subsequent years breeding colonies established themselves in Glamorgan, Pembrokeshire, Ceredigion and even in

Caernarfon / Anglesey. The largest count, to date was of 393 at Penclacwydd, Carmarthenshire in September 2005.

Dartford Warblers are a scarce heathland-breeding bird in the UK, with its range originally restricted to areas in the south of England, such as Dorset and the New Forest. Its precarious survival as a British breeding bird was despite high winter mortality from the cold winters and long periods of frost. With milder winters from mid 1990's onwards, small populations developed in Devon. It has been suggested that individuals from here started to colonise the coastal heathland of the Gower in 1997. Others were then discovered breeding in Gwent, then East Glamorgan, followed by Pembrokeshire and Carmarthenshire. Others have recently been reported in Ceredigion, Caernarfon, Denbigh and Anglesey. It has been a remarkable success story, impossible to imagine without the effects of climate change.

Mediterranean Gulls, once a great rarity in Wales (the first Welsh record was only in 1964) are now regularly seen at many sites in Wales, particularly in the South-West (Pembrokeshire, Ceredigion, Carmarthenshire and Glamorgan) in autumn, winter and spring. Indeed the numbers of this gull (which breeds around the Aegean, Black Sea and more recently Netherlands, SE England and even Ireland) have increased so much that since 2003 there have been too many in Wales to allow an accurate assessment of the numbers involved (Figure 7). The milder winters of SW Wales have suited the northward expansion of this species, one day they may even stay to breed.

Other species appear to be visiting Wales more often these days than they did in the past. One such example is the Mediterranean Shearwater which breeds in the Mediterranean and follows the warmer oceanic currents up past Wales to feed in late summer and early autumn. The annual totals of individuals seen off Strumble Head, Pembrokeshire, are shown in Figure 8. Although there are large annual differences, and assuming observer effort is similar from one year to the next, the total number of individuals recorded passing Strumble Head do seem to have increased over the last 14 years (the peaks refer to autumns dominated by SW storms, which blew the birds up into the Irish Sea).

As with resident Welsh seabirds, it has been suggested that the warmer water, coming up from the Bay of Biscay, is being mixed with nutrient rich water from further out in the Atlantic, leading to improved growing conditions for algae and plankton, which in turn is powering a more productive food chain. Research has shown greater populations of phytoplankton, sprats, anchovies and sardines (R.B. Wynn, pers comm.).

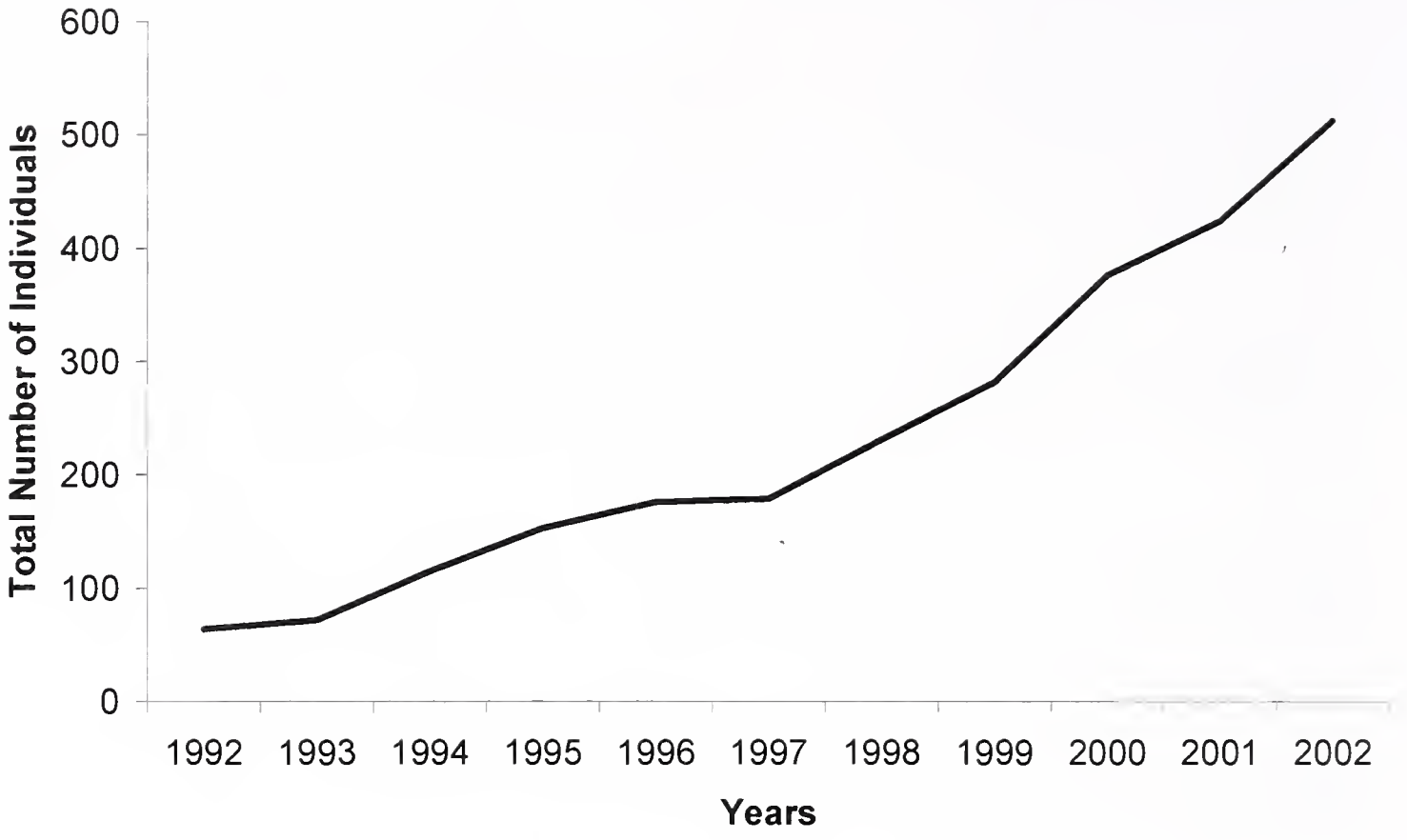


Figure 7. Number of Mediterranean Gulls reported in Wales 1992 – 2002.

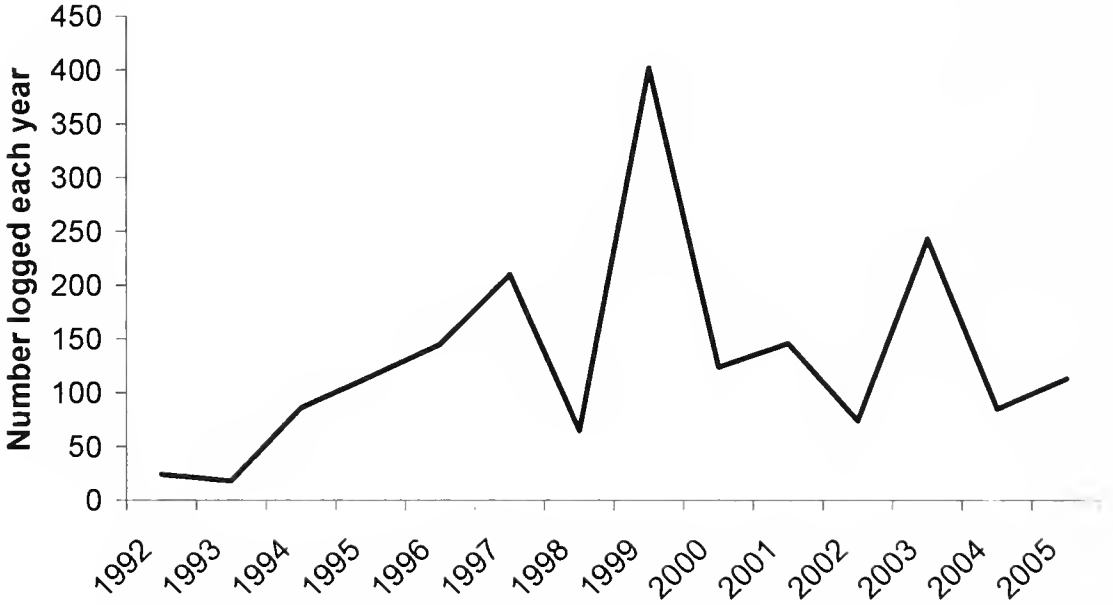


Figure 8. Number of Mediterranean Shearwaters reported off Strumble Head, Pembrokeshire 1992-2006.

One can only speculate what other species may follow these. Great White and Cattle Egrets are increasing in Europe and are moving closer to our shores. The former is reported nearly annually in Wales, while there was a large influx of Cattle Egrets into SW Britain during November 2007 which produced at least two Welsh records. Other species may also follow these, one species often mentioned in Hoopoe – it has bred in Wales once. Perhaps this may become a more common event, who knows.

ACKNOWLEDGEMENTS

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THE POPULATION STATUS OF BREEDING GOLDEN PLOVER AND DUNLIN IN WALES IN 2007

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SUMMARY

1. The Golden Plover is red-listed Wales, and is one of the Assembly Governments' 51 Principal Biodiversity Species. The aim of this survey was to establish baseline population size and range to meet the first Wales Biodiversity Action Plan objective for the species. The Dunlin is amber listed for its' wintering population, but small numbers breed in Golden Plover habitat, and both were surveyed at the same time.
2. The Brown & Shepherd method was used to survey of 370 1km squares divided between those with records since 1994 and adjacent squares, grouped by 12 sites.
3. Results suggest a breeding Golden Plover population of 36 pairs in 21 km squares across seven sites, and a Dunlin population of 17 pairs in 16 km squares on just one site. For Dunlin however, coverage of all historic breeding sites did not occur and this figure represents a minimum.
4. National range decline has continued for Golden Plovers, birds being absent at five sites. A trend in abundance was only possible for the most populous site, the Elenydd, where they declined by 88% since 1982. In contrast Dunlin declined by 36% in the same area.
5. Hypotheses proposed to explain Golden Plover declines include changes in predation, nesting habitat, foraging habitat and food abundance. Incomplete data are likely to prevent a detailed understanding of this decline. However, habitat on the Elenydd, is reported to have changed in recent years. Data to quantify this and inform management trials are urgently required to prevent extinction in Wales.

INTRODUCTION

Golden Plovers *Pluvialis apricaria* breed on upland bog habitats along with Dunlin *Calidris alpina*, and in Wales the range of these breeding waders has always been largely restricted to a number of upland sites (Lovegrove *et al.* 1994). Most of these sites are designated as SSSIs, although none have Golden Plover as a feature species. Instead, they are included as one of an assemblage of upland birds.

Data from the repeat BTO Atlas (Gibbons *et al.* 1993) suggest range contraction in Wales towards the upland blocks of Hiraethog, Migneint, and Elenydd (Fig.1). Successive surveys on these and other sites similarly suggest population decline since the 1970s (Tables 1 & 2). However, methods and coverage have varied over time and have not formally been coordinated to produce all-Wales population estimates, although surveys from the late 1970s are often reported in this way. Golden Plover has been red-listed in Wales by Thorpe & Young (2003), on account of localised distribution and >50% decline in numbers over the last 25 years.

The Welsh Assembly Government has published an action plan for Golden Plover. The first objective of this plan is to establish a baseline for abundance (population size) and range (number of occupied 1km squares) through species specific monitoring, against which the success of conservation action will be measured. Consequently, the aim of this survey was to measure the size and range of the Golden Plover population in Wales.

Dunlin, amber listed for its declining winter population (Thorpe & Young 2002), breed in small numbers in similar habitat to Golden Plover (Lovegrove *et al.* 1994), and breeding Dunlins were also recorded. However, there are differences in Golden Plover and Dunlin distribution on some sites, and resource constraints prevented full coverage of all 1km squares with Dunlin records from being achieved.

METHODS

Design

Systematic coverage was divided between two strata composed on 1km squares. This unit of survey was selected because records of boundaries used by previous surveys either varied over time or were incomplete. Furthermore, the 1km square is the unit of range in the BAP. Stratum-1 was a full survey of 1km squares where Golden Plover were recorded since 1994 (termed historic). Two sites, Llanbrymnmair and Trannon Moor were occupied in the 1970s, but not surveyed in 2007 because there were no records since 1994. Stratum-2 was full coverage of a 1km buffer around those squares to evaluate range change (termed buffer squares). These buffer squares included much of the blanket bog on the 12 sites. Although this approach ensured that sites or parts of sites, with recent records were visited, some suitable habitat with no recent records was not surveyed. Numbers of squares in each stratum are shown in table 3.

Field method

The Brown and Shepherd (1993) method for censusing upland breeding wader populations was used. Two visits were made to each square (visit 1: Apr 2nd – May 15th, visit 2: May 16th – June 30th). Suitability of habitat was assessed during the first visit, and areas considered unsuitable (steep slopes, conifer plantations, improved pasture)

were not surveyed. The extent of potential breeding habitat (peat hags, short heather and bare areas) was marked on a 1:25,000 scale map.

Table 1. Numbers of pairs of Golden Plovers from previous surveys in Wales. Survey method for each is summarised below (B&S = Brown & Shepherd). For 2007, figures following a '+' show number of pairs on the site but outside the 1km squares selected for survey.

Site	1975-78	1981	1982	1983	1986	1990	1992	1993	1994	1995	1999	2007
Berwyn	20+ [1]			25 [5]	3+ [6]		10 [8]	2-8 [10]				6 + 1
Black Mts	7 [1]											5
Elenydd	80+ [1,2]		112 [5]			46 [7]				39 [12]		11
Hiraethog	46 [1]	34 [4]							8 [11]		3 [14]	2
Llanbrynmair	25-35 [1]											
Migneint	18 [1]									10-11 [13]		7 + 1
Mynydd Du	2 [1,3]						1 [9]					2
Pumlumon	6-7 [1]											1
Ruabon	4+ [1]											0
Trannon moor	2 [1]											
Total	**213+**											**36**

[1] Lovegrove *et al* (1994) methods not given (northern section only for Mignient).
[2] Davies *et al.* (1978) Breeding birds of a Welsh Upland area. Unpublished report.
[3] Davies (1978) mix of mapping (Enemar 1959) and BTO Atlas method. [4] Davies (1982) mapping records along transects 200m apart. [5] Davies (1983) mapping records along transects 200m apart. [6] Williams (1986) *ad hoc* records during raptor survey.
[7] Leversley *et al* (1990) combination of transects and 'look see' methods. [8] Green & Walker (1992) no clear method. [9] Harris (1992) mix of mapping (Enemar, 1959) and BTO Atlas of Breeding Birds. [10] Green & Kenmir (1993) no clear method. [11] Thomas & Young (1994) B&S method. [12] Young *et al.* (1996) B&S method. [13] RSPB (1995) modified B&S method. [14] Lamacraft (1999), B&S method.

The rate of coverage recommended by Brown & Shepherd (1993) was adhered to when surveying suitable breeding habitat. GPS was used so that the area was methodically walked to within 50m of all points, with regular scanning for birds. Time spent in

habitat considered less suitable (largely rank *Molinia*) was reduced and not strictly timed, although the areas were scanned approximately every 100m. This was because of resource and weather constraints. For example, although surveying during poor weather conditions was minimised, it did take place on occasion during June if conditions deteriorated after long walks to remote survey areas, particularly on the Elenydd. With the help of GPS, the location and behaviour of all Golden Plover and Dunlin records were plotted on a 1:25,000 scale map using standard BTO activity codes.

Table 2. Numbers of pairs of dunlins from previous surveys in Wales. One record on the Black mountains in 2007 did not represent a territory based on the Brown & Shepherd method.

Site	1975-78	1981	1982	1983	1986	1989	1990	1991	1992	1993	1994	1995	1999	2007
Berwyn	2 [1]			3 [6]	2 [6]	2 [7]	0 [7]	1 [7]	2 [7]	1 [10]				0
Black Mts														0
Elenydd	37 [2]		**41** [5]				28 [8]	37-40 [8]				30 [12]		17
Hiraethog	2 [3]	**4-5** [4]									3 [11]		3 [13]	0
Migneint	1 [1]													0
Mynydd Du								**0** [9]						0
Pumlumon														0
Total	**42**													**17**

[1] Lovegrove *et al* (1994) methods not given. [2] Davies *et al.* (1978) 'look-see' method. [3] Potts (1977) 'look-see' method. [4] Davies (1982) mapping records along transects 200m apart. [5] Davies (1983) mapping records along transects 200m apart. [6] Williams (1986) *ad hoc* records during raptor survey. [7] Green & Kenmir (1993) no clear method. [8] Leversley *et al* (1990) combination of transects and 'look see' methods. [9] Harris A (1992) mix of mapping (Enemar 1959) and BTO Atlas method. [10] Green & Walker (1992) no clear method. [11] Thomas & Young (1994) B&S method. [12] Young *et al* (1996) B&S method. [13] Lamacraft (1999) B&S method.

Population estimates

A full survey approach was used. Therefore, the population size was the sum of the territories identified by applying the Brown & Shepherd (1993) interpretation guidelines to all registrations within the survey area (summarised in Young *et al.* 1996).

RESULTS

Coverage

This was close to complete, with 96% of historic squares and 83% of buffer squares receiving coverage (Table 3). The presence of unsuitable habitat was the main reason for not surveying buffer squares. However, two records were received from outside the survey area (Table 1), and provided unambiguous evidence of breeding pairs based on the Brown & Shepherd method.

Number of pairs

Overall, 36 pairs of Golden Plovers were found, with 11 (31%) on a single site (the Elenydd, Table 1) and 2 (6%) outside the 1km squares selected for full survey. Overall, nine (36%) of 25 occupied squares were in 'buffer' squares (Table 3). Because the behaviour of the birds reported from outside the survey areas was unambiguously that of breeding pairs they were added to the sum of pairs from within the formal survey areas.

Seventeen pairs of Dunlins were found in 16 1km squares, all of these on the Elenydd (Table 2). A record of Dunlin on the Black Mountains did not represent a territorial pair based on the Brown & Shepherd method. From the outset, coverage was considered incomplete for Dunlin, and this figure represents a minimum population size for Wales.

Trends

Golden Plovers were absent from five of the 12 sites surveyed suggesting continued range contraction. Dunlins were restricted to one site, but because a full survey of historic sites with Dunlin was not carried out, trends in range based on these data may be misleading.

Repeat surveys of individual sites have not used the same field method or survey boundary (Table 1), and because of this, quantifying trends in abundance within sites is more difficult. Overlaying survey boundaries to delineate the area covered by all identified a common survey area. Individual territories from each survey were then mapped using survey reports and archived data. Trend in abundance was measured as change in the number of territories within the common survey area. This was only possible to the Elenydd, for which archived data were complete. Between 1982 and 2007, Golden Plovers had declined by 88% while Dunlins had declined by 36% (Fig.2).

DISCUSSION

Coverage and accuracy

Survey accuracy is difficult to measure (Gregory et al. 2004), and this was not attempted for the selected survey area. Pearce-Higgins & Yalden (2005a) compared population size estimated using the Brown & Shepherd method with that using mark-resighting data, and found that populations may be significantly underestimated when densities are high. However, they found that for low-density populations, such as in Wales in 2007, accuracy was better. Therefore, because coverage was close to complete, accuracy within the selected survey areas was considered acceptable.

However, the two additional records show some Golden Plover territories were outside the 1km squares selected for survey and others may have been missed. The survey could have considered a longer time-period for including historic records at the design stage to further widen coverage of suitable habitat in Wales. However, this approach would not have been cost effective given the low likelihood of finding breeding birds in such places. Overall, very few other territories are likely to have been missed, and overall accuracy was considered adequate. The Dunlin population estimate was a minimum because not all historically occupied sites were surveyed.

Weather during the 2007 breeding season was unusually wet. Breeding Golden Plover and especially Dunlin populations are likely to fluctuate between years depending on prevailing weather conditions (Lovegrove *et al.* 1994), and it is possible that numbers were unusually low in 2007 because of this.

Extent of decline

The first major upland bird surveys in the UK took place in Wales in the late 1970s (e.g. Davies *et al.* 1978), and these data provide a glimpse of how abundant some upland birds were compared with today. However, methods for such surveys were in their infancy and coverage was not always complete. Because of this, the results of these surveys unfortunately cannot be used as baselines for measuring trends in abundance (Fig.2).

However, at least on the Elenydd, where trend in abundance could be measured, the decline in Golden Plover was too great to be explained by survey error or poor weather alone and these results provide good evidence for continued serious decline in abundance in Wales. The decline in abundance and range in Wales fits within a wider pattern of decline in Western Europe (Tucker & Heath 1994). Young *et al.* (1996) and Buckton *et al.* (1997) report the Dunlin population declining much less than Golden Plover, and this pattern has continued.

There was evidence for some variation in distribution over time within sites, with around one third of buffer squares without previous records containing Golden Plover territories in 2007. In many cases, this is likely to be largely an artefact of territories (as defined by the Brown & Shepherd method) varying by small distances within patches of suitable habitat rather than significant changes in habitat occupation.

Causes of decline

An increase in predation has previously been suggested as a cause of decline in breeding Golden Plovers (Lovegrove *et al.* 1994, Buckton *et al.* 1997) by reducing breeding success to the point where mortality of breeding adults exceeds recruitment. This has been linked to aforestation (Parr 1992), plantations providing a refuge for crows and foxes, and a decline in game keeping (Lovegrove *et al.* 1994).

Off duty breeding birds in some populations are known to preferentially feed in poorly drained pasture with high *tipulid* abundance, and with short swards in spring that ensures prey are accessible (Pearce-Higgins & Yalden 2003). It is well known that intensification of grass management has taken place in the upland fringes in Wales in recent decades. However, data on the use of enclosed pasture by breeding Golden Plovers in Wales are absent. Therefore, it is unclear whether a decline in this behaviour,

coincident with intensification has gone unreported, or whether Golden Plovers in Wales have always preferred moorland habitats for foraging during breeding.

Table 3. 1km square coverage achieved during the 2007 survey. Squares not visited were those with >75% unsuitable habitat (predominately steep slopes, plantation or enclosed farmland). Figures in brackets show how many of those squares were part visited due to lack of access.

	Selected		Visited		Not visited		Occupied by Golden Plover	
	Historic	Buffer	Historic	Buffer	Historic	Buffer	Historic	Buffer
Site								
Hiraethog	13	41	13	29	0	12	0	2
Migneint	17	49	13	24	4	25	4	1
Ruabon	1	8	1	8	0	0	0	0
Berwyn	4	30	4	26	0	6	2	3
Pumlumon	2	16	2 (1)	16 (2)	0	0	0	1
Elenydd	50	132	50	124	0	8	7	1
Aberedw	1	8	1	8	0	0	0	0
Glascwm	1	8	1	8	0	0	0	0
Black Mts	3	12	3	12	0	0	2	0
Brecon Beacons	2	12	2	8	0	4	0	0
Mynydd Du	1	8	1	8	0	0	1	1
Brechfa	1	8	1	5	0	3	0	0
Total	**96**	**332**	**92**	**276**	**4**	**56**	**16**	**9**

Golden Plovers occur in highest densities where heather is short and vegetation density is low (Pearce-Higgins & Grant 2006). Management on the largest site, the Elenydd, has changed in recent decades and this is likely to reflect wider changes in the uplands of Wales. Changes include historic aforestation, and more recently reductions in sheep numbers and cessation of grass and heather burning for nature conservation. However, interpretations of the impact of these changes on Golden Plovers seem contradictory. One view is that excessive grazing was contributing to the decline through conversion of heather to grass and nest trampling (e.g. Crick 1992). An alternative view is that habitat has become less suitable for nesting and chick rearing through reductions in sheep grazing and moor burning (Lovegrove *et al* 1994). However, data on management practices and habitat characteristics are generally patchy or lacking at the farm holding scale, making testing hypotheses concerning the decline difficult (Buckton *et al* 1997).

Finally, changing climate may have impacted on food supplies for adults and chicks, and there is evidence that their *tipulid* food supplies and timing of breeding are sensitive to warming (Pearce-Higgins *et al.* 2005b). However, while such changes may accumulate in the future to impact bird trends, there is no evidence that such changes explain past declines.

Whatever the cause or causes of decline, it is clear that, at least on the Elenydd, they have impacted differently on Golden Plover and Dunlin.

Next steps

The best understanding of bird population declines requires data on demographic rates such as breeding success (chicks fledged per pair) and survival. However, there are no such data for Golden Plovers in Wales, although some nest success data (percentage of nests hatching) are provided by Thomas *et al.* (1983).

However, when, as is often the case, the cause of decline of a priority species is not conclusively identified precautionary management demands that as many perceived ecological problems as possible are addressed. For example, conservation management for Cirl Buntings *Emberiza cirlus* has been a success (Peach *et al.* 2001) despite no study formally identifying any single limiting factor. Instead, implementing prescriptions to improve habitat quality during both breeding and winter, based on studies of the birds' ecology, resulted in a population increase relative to places where they were not implemented.

For the Elenydd, vegetation monitoring baseline data already exists, consisting of 28 30x30m plots located with reference to habitat composition stratified by holdings that were expected to vary in their future livestock management. Green *et al.* (1994) use their base-line data to suggest limits of acceptable change and time-scales over which this should be detectable (by 2003). Indeed, based on the suggested time-scale for repeat surveys of 5-10 yrs, 1-2 repeats should already have taken place. Such data could be used to quantify the suggested changes in habitat characteristics across the site.

Depending on the results of vegetation monitoring, management trials could be carried out. Such trials should use large (>100ha) replicated plots, following a before-after control-impact design. The hypothesised response would be preferential settlement or use of managed areas by Golden Plovers. Although the small population may make significant effects hard to demonstrate at the bird-level, change in characteristics towards those preferred by Golden Plovers (Pearce-Higgins & Grant 2006) would provide evidence for success at the habitat level.

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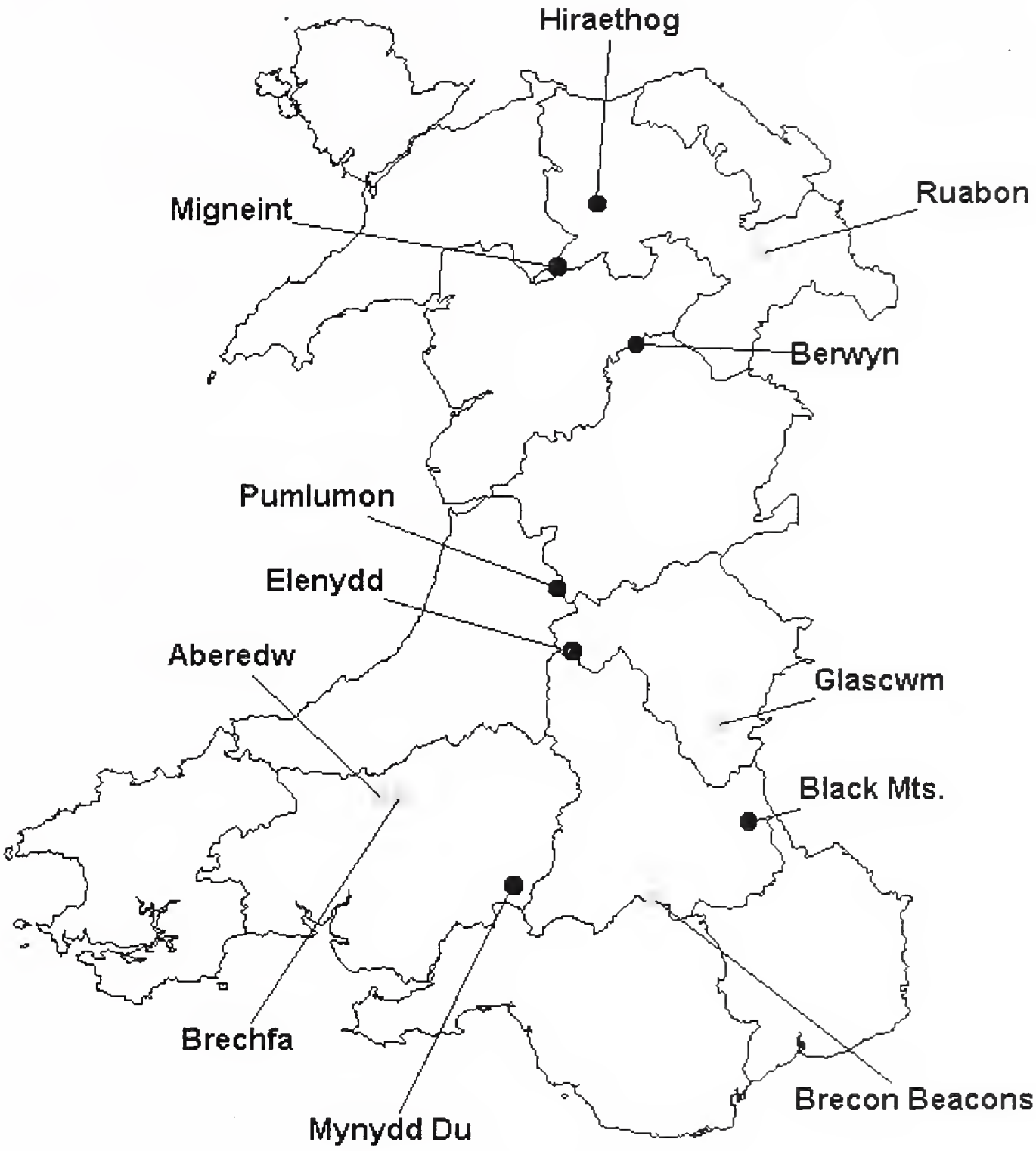

Figure 1. Upland sites with records of breeding Golden Plover since 1994 (grey) and in 2007 (black), in relation to the vice counties. Two sites surveyed in the 1970s, Llanbrynmair and Trannon Moor, were not resurveyed in 2007 because they had had no records since 1994. Territorial Dunlin were only found on the Elenydd.

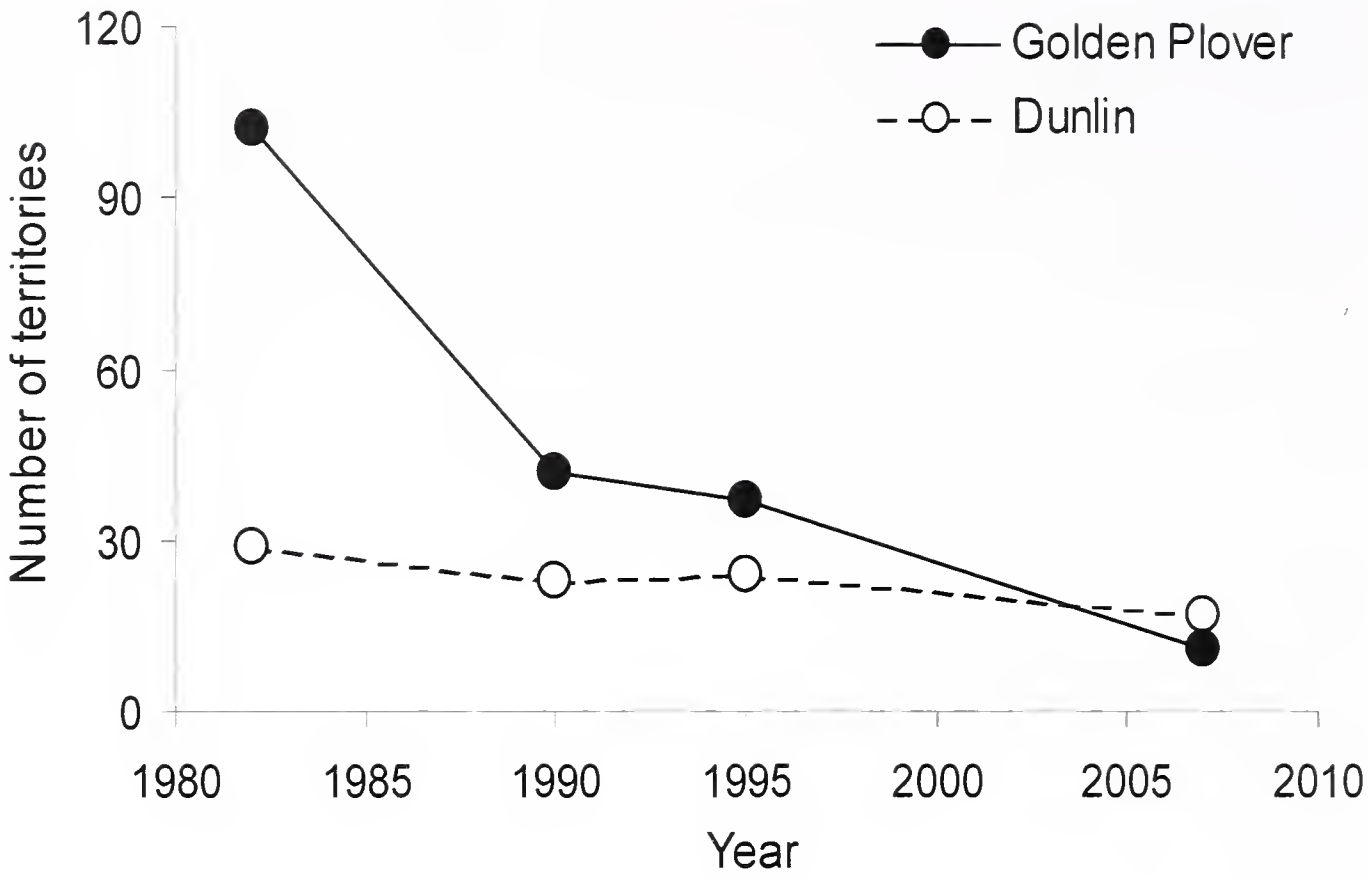

Figure 2. Change in the number of breeding Golden Plover and Dunlin pairs in the Elenydd SSSI. Numbers shown may be less than previously published because they have been adjusted to represent the common survey area. In 1982 a systematic line transect method was used. In 1990 a mixture if line transect and 'look see' method was used. In 1995 and 2007, the Brown & Shepherd method was used. A calibration exercise by Young et al. (1995) suggested transects and Brown & Shepherd were comparable. Because it a non-specific 'look-see' method mixed with transects, the 1990 survey is probably least comparable to other years. Method and coverage in the 1970s surveys meant results were not comparable, and the results are not shown.

BIRD-WATCHING HELPS TARGET CONSERVATION MANAGEMENT FOR BIRDS OF FARMED HABITATS

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Summary

1. Halting priority bird declines requires the provision of missing critical resources in places where they can be used. Agri-environment prescriptions are increasingly good at providing species-specific food and nest sites. However, a process to target these where they will be of benefit to remaining populations is lacking. This paper describes an ecologically-based way of achieving this for nine of the Principal Biodiversity Species in Wales.
2. The approach uses records of numbers of birds in 1km squares over the last 6-8 yrs. National coverage from organised surveys alone was too low or infrequent to inform targeting. Therefore, data from all sources, including casual bird watching records were included.
3. After quality control, important sites were identified using appropriate threshold abundance values, and resulting key-areas delineated using radii based on the likely movements of each species. Bird watching records made up the majority of data used in 4 cases.
4. These, along with key-areas for some priority species from other taxa, are already being used by the Welsh Assembly Government to highlight the presence and needs of different priority species when applications for Tir Gofal are received from within their respective key-areas.
5. The informal nature of some records means that key-areas do not formally measure range. Nevertheless, they do provide a simple graphical way to guide the right conservation management to the right places. Bird populations change over time, and the key-areas will be updated biannually to reflect this. The continued submission of records of all Principal Biodiversity Species from bird watchers will be vital to this process.

INTRODUCTION

There is overwhelming evidence of farmland bird declines in the UK, and data suggest that these are equally severe for some birds of farmed habitats in Wales (Johnstone *et al.* 2006). However, because many birds remain widespread despite such declines, site designations and nature reserves are not appropriate ways to safeguard them. Instead, agri-environment schemes represent the likeliest mechanism to influence their populations in the wider countryside.

To be effective in halting or reversing these declines, agri-enviroment schemes must provide missing critical resources, both in places where they can be used and in sufficient quantities to improve breeding success and survival. These have received much attention in recent years in the UK, and the food and nesting requirements of many Principal Biodiversity Species living in farmed habitats are now well understood (Vickery *et al.* 2004, Lamacraft *et al.* 2008). However, the second of these has received less consideration. Many of the birds of farmed habitats that have declined in Wales

have limited dispersal abilities (Paradis (1998) Wernham *et al.* 2002) and now occupy restricted geographic distributions (Lamacraft *et al.* 2008). Therefore, it is essential that conservation management for these species be targeted to these places, or close enough to them for birds to find it given likely movement patterns. There is clear evidence in the recovery of Cirl Buntings *Emberiza cirlus* in SW England that targeting action in this way works (Peach *et al.*). Furthermore, such geographic targeting will ensure limited resources deliver best value for money in meeting the Welsh Assembly Government's biodiversity conservation targets. The third requirement remains an area of research, the results of which can easily be integrated into established methods of targeting species-specific prescriptions to these places, termed key-areas.

This idea of key-areas underpins the Bird Conservation Targeting Project (BCTP), a UK-wide project implemented at the country level in Wales, Northern Ireland and England (there are plans to extend the BCTP to Scotland). In Wales, the BCTP is supported by partners: the Countryside Council for Wales; Forestry Commission Wales and the British Trust for Ornithology. Local Record Centres and County Bird Recorders are also central to the project in Wales. The aim of the BCTP is to develop a semi-automatic system that highlights places where priority bird species are still known to be breeding, and which can be updated much more often than the formal UK bird atlases.

In previous species projects in Wales, key-areas have been identified using a combination of data on distribution, abundance and movement pattern. This approach has proved effective for targeting habitat management for Black Grouse *Tetrao tetrix* (Lindley *et al.* 2003) and protecting habitat for Choughs *Pyrrhocorax pyrrhocorax* (Lamacraft 2004). For these two species, key-areas have now been refined, and new ones developed for a further seven of the 26 Principal Biodiversity Species occurring in farmed habitats, using data collated for the BCTP (Table 1). The aim of this paper is to describe the data and method used to delineate key-areas, and highlight the contribution made by bird watchers submitting casual records.

METHODS

Approach

In Wales, the key-areas were identified using three kinds of ecological information; firstly, distribution based on records of birds from different locations; secondly, abundance using the count of birds from each record and thirdly, a value for distance moved, selected from a review of natal dispersal (distance from their natal nest that birds will travel before breeding), seasonal dispersal (distance travelled between breeding and non-breeding areas), and foraging movements (distance travelled from nest to feeding sites), usually based on ringing data.

Data sources

National and regional surveys and species projects provide data to the BCTP. However, national coverage by these is too low or infrequent to be useful for targeting because some species remain relatively widespread. Consequently, records from bird watchers submitted through County Recorders, or online through BirdTrack or the National Biodiversity Network (NBN) gateway, were also added to the BCTP. All data were verified, where possible, by national and county experts as breeding records before inclusion in the confidential BCTP database. This is to ensure they represent reliable

information on the places where species are still known to be breeding. These data are the starting point for delineating key-areas.

Data processing

From the outset, key-areas were intended to be as inclusive of records as possible. However, various degrees of exclusion were required to ensure maps do effectively highlight the main population centres. Therefore, although the approach was the same for all nine species, different thresholds for inclusion of records were used for each. The data processing steps are described as follows:

Step 1: Data collation. For most species, a 6-year period, currently 1999-2005, was chosen to be in-line with the UK BCTP. For Curlew *Numenius arquata* however, an eight-year period 1997-2005 was used to incorporate regional surveys in otherwise under represented areas. The locations of records from the different sources were standardised to 1km grid squares, as original records varied in their resolution. Place names were only assigned grid references if this could be done unambiguously. Those without grid references, or where it was not possible to allocate a grid reference, were rejected. Abundance data were also standardised to the same count unit (Table 2). Breeding and wintering records were pooled for Grey Partridge *Perdix perdix*, Chough, Tree Sparrow *Passer montanus*, Yellowhammer *Emberiza citrinella* and Corn Bunting *E. calandra*.

Step 2: Important site selection. For each species, an abundance threshold was selected to identify those records with the greatest number of birds, termed 'important sites'. Sites were individual 1km squares, but adjacent squares were pooled for the following species. For lapwing and curlew, important sites were based on the maximum count summed across adjacent squares with records in the same year. For Grey Partridge, Tree Sparrow and Yellowhammer, important sites were based on the maximum count summed across adjacent squares with records even if from different years (Table 3). This method ensured the same weight was given to one square containing 10 pairs as 10 adjacent squares each with one pair.

Where possible this threshold was 1% of the Welsh population, in common with Special Protection Area qualification, and was used for Lapwing *Vanellus vanellus*, Chough and Black Grouse. This threshold was impractical for the other species.

Curlews occur at low densities, therefore the maximum number of pairs occurring at any one site is low, and only a few locations would qualify using the 1% threshold. For this species two pairs was used as the threshold.

Yellowhammer and Tree Sparrow are still relatively abundant in Wales, despite recent declines. For example, Green (2002) estimated around 38,500 pairs of Yellowhammer in Wales by extrapolation, and this figure is probably of the correct order of magnitude. A site would therefore need to contain 385 pairs before it could be considered important using the 1% threshold, and no site met this level of importance. For these species, therefore, the top 10% of sites by abundance were selected as important.

The 1% threshold was also impractical for Grey Partridge, Corn Bunting and Turtle Dove *Streptopelia turtur* because they were so scarce their key-areas would be too exclusive. In these cases, all records were treated as important sites.

In practice, the important site threshold was chosen by selecting from a range of draft maps, that which produced key-areas that visually best met the objective of targeting conservation management to main population centres.

Step 3: Mapping key-area boundaries. The important sites (single or groups of adjacent 1km squares) were then mapped. A radius was drawn around these, determined by knowledge of movement distances for each species (Table 3). Data on seasonal dispersal was used in preference to other values for resident seed eaters to ensure both breeding and wintering sites were included in key-areas, while natal dispersal was appropriate for waders, which winter away from the breeding sites. For two birds, daily movements were most appropriate: foraging movements from nests and communal roosts were used for Choughs, while for Black Grouse, home range size of males (expressed as a radius) was used.

Step 4: Mapping constituent sites. All other records, termed 'constituent sites', falling within this initial boundary were then mapped, and the initial boundary extended by the same radius from these to form the final key area boundary.

RESULTS

The key-areas maps generated for each of the nine species are shown in Fig 1. Key-areas varied in their extent, ranging from <1% of Wales for Corn Buntings, to over 30% for Yellowhammers (Table 1).

Table 1. The population size, status and land within key-areas for nine birds of farmed habitats. All are Principal Biodiversity Species.

Species	Population size	Population status	Key-area (ha)	Area as % Wales
Black Grouse	213 [1]	Red	820	4
Grey Partridge	Unknown	Red	1,726	8
Lapwing	6-700 [2]	Red	1,779	9
Curlew	1,099 [3]	Red	6,535	32
Turtle Dove	<5 [4]	Red	361	2
Chough	262 [5]	Amber	1,557	8
Tree Sparrow	Unknown	Red	4,053	20
Yellowhammer	Unknown	Red	8,797	42
Corn Bunting	<5 [6]	Red	44	<1

[1] Lindley *et al.* (2007). [2] 1,698 pairs in 1998 (Wilson *et al.* 2001) used, although extrapolation from available data suggests 600-700 pairs in 2006. [3] Johnstone *et al.* (1997a). [4] Monmouth Turtle Dove project 2005 and 2006 . [5] Johnstone *et al.* (2007b). [6] RSPB unpublished partial survey 2006.

The composition of the data used to delineate key-areas also varied between species (Fig. 2). For four of the species, however, the majority of data were records from bird

watchers submitted through County Bird Recorders, BirdTrack, RSPB, and the NBN gateway.

Table 2. The method used to delineate key-areas varies between species to account for differences in ecology. Nationally important = ≥1% of Welsh population. Although a nationally important population of Curlews is 11 pairs, no sites reached this threshold. Based on information from the BCTP database a figure of two pairs was selected.

Species	Unit of record	Important site threshold	Movement distance	Comments
Black Grouse	Lekking male	All records treated as important sites	1.5km	
Grey Partridge	Individuals	All records treated as important sites	3km	Released birds excluded where known
Lapwing	All probable breeding pairs Apr-Jun	≥6 pairs pooled across adjacent squares in same year	2km	
Curlew	All probable breeding pairs Apr-Jun	≥2 pairs pooled across adjacent squares in same year	2 km	5km used due to dispersal distances of >10km
Turtle Dove	All records of singing and other records with two sightings ≥10 days apart counted as territories	All records treated as important sites	5km	5km used due to dispersal distances of >10km
Chough	Pairs (breeding) or individuals (non-breeding)	Nationally important (≥3 pairs <2km apart, or 6km radii from roost with ≥13 birds	Breeding 2km. Non-breeding 6km	Distance from nest during breeding (Whitehead *et al* 2005) 95% of same day winter records using same roost (Cross Stratford & Young *pers comm*)
Tree Sparrow	Standardised to individuals	Top 10% sites (≥12 birds), 5km buffer applied, further 5km buffer applied to constituent sites falling within the initial buffer to form key area	5km	5km used due to dispersal distances of >10km
Yellowhammer	Standardised to individuals	Top 10% sites (≥8 birds), 5km buffer applied, further 5km buffer applied to constituent sites falling within the initial buffer to form key area	5km	
Corn Bunting	Standardised to individuals	All	5km	5km used due to dispersal distances of >10km

Table 3. A review of dispersal distances of the nine priority birds for which ecologically based key-areas have been developed. The movement distance used to identify key-areas is also shown.

Sp.	used	Source																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
BK	1.5															1.5				
P	3							5				5								
L	2																2			
CU	5																	20		
TD	5								7	11			0.6	1.3						
CF	2/6																		2	6
TS	5	<1	<1	<1							5-10		0.3	0.7	<5					
Y	5	<1	2	<2	1						5		0.2	2	<4					
CB	5	4				2.4	21													

1. Wernham *et al.* (2003), median distance between ringing and recovery. 2. Wernham *et al.* (2003), median natal dispersal. 3. Wernham *et al.* (2003), median breeding dispersal. 4. Wernham *et al.* (2003), median dispersal between winter seasons. 5. Wernham *et al.* (2003), average dispersal within breeding season. 6. Wernham *et al.* (2003), average seasonal dispersal (summer-winter). 7. Wernham *et al.* (2003), maximum natal dispersal (summer-winter). 8. Wernham *et al.* (2003), average natal dispersal. 9. Wernham *et al.* (2003), average breeding dispersal. 10. RSPB Conservation Management Advice Note, seasonal dispersal. 11. RSPB Conservation Management Advice Note, natal dispersal. 12. Paradis *et al.* (1998), breeding dispersal (geometric mean). 13. Paradis *et al.* (1998), natal dispersal (geometric mean). 14. Calladine *et al.* (2004), within winter dispersal. 15. Cayford *et al.* (1989). 16. Thompson *et al.* (1994) within-season dispersal. 17. Wernham *et al.* (2003) median natal dispersal. 18. Whitehead *et al.* (2005). 19. Cross, Stratford & Young (*pers. comm.*).

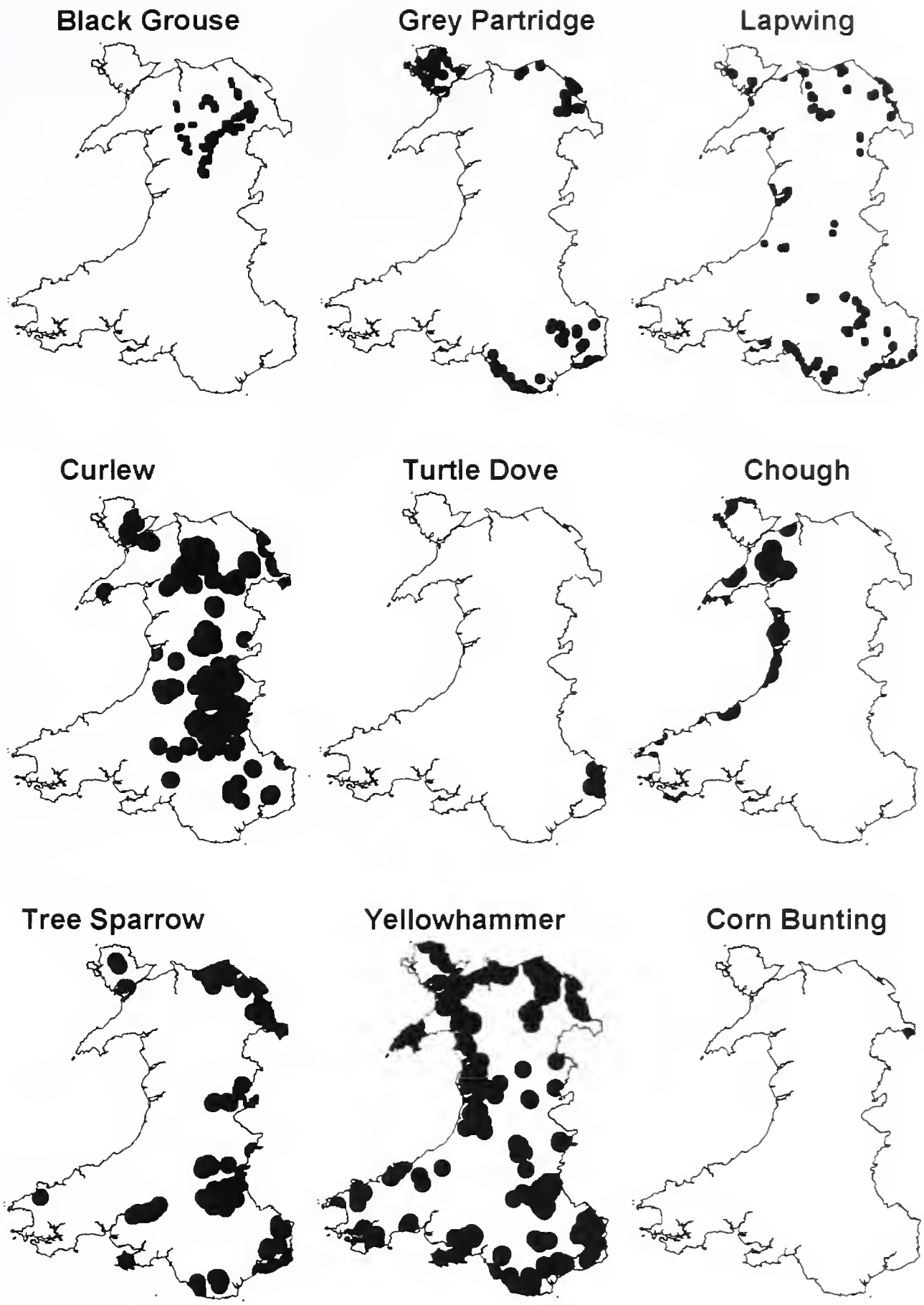

Fig.1. Key-areas for nine birds of farmed habitats produced using data from range of sources. Data covers the period 1999-2005, and 1997-2005 for Curlew.

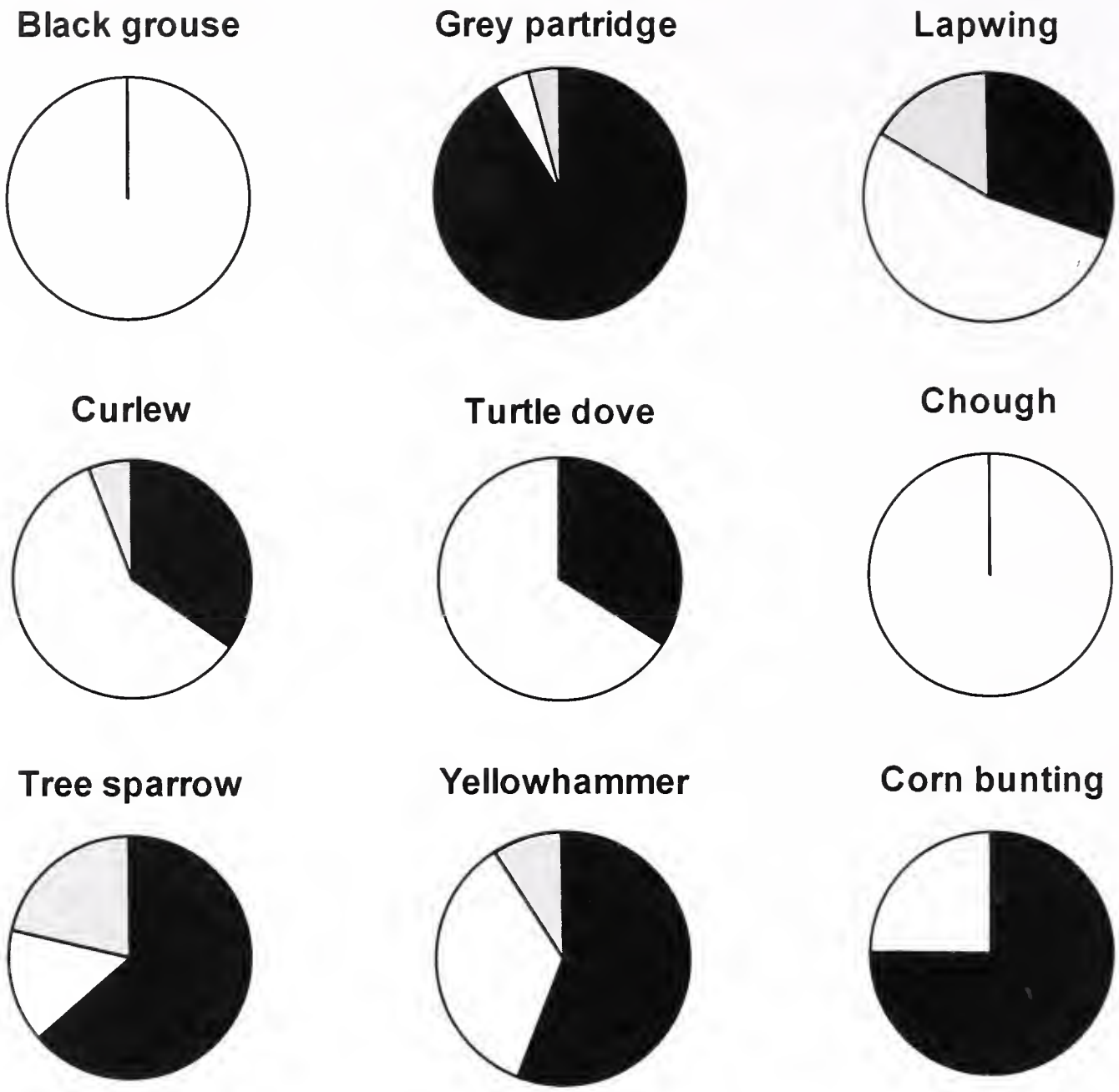

Fig. 2. The proportion of records from different sources used to create the key-areas. Black shows casual records (e.g. County Bird Reports); white shows projects (e.g. Cross & Stratford Chough Colour-ringing Project, Monmouthshire Turtle Dove Project and RSPB's Aren't Welsh Birds Brilliant), and grey shows records submitted through BirdTrack.

DISCUSSION

Future updates

Key-areas are expected to change over time. Because of this, revision will take place every two years: the next revision planned for March 2009 using data from 2001-2007. It is also possible that the method for producing maps will be refined over time.

If Principal Biodiversity Species decline, range contraction is inevitable. This will be reflected in key-areas by fewer records from fewer places. An individual key area will be considered 'extinct' when there are no records for the previous three years. In practice, this rule will only be applied to the scarcest or most range restricted species, for which formal data exist on range and abundance (e.g. Black Grouse and Chough). Similarly, unless based largely on formal survey data, increase in the number and size of key-areas is not necessarily evidence that population size and range is increasing. Furthermore, without good evidence linking conservation management to population-level effects, such increases in key-areas extent and number cannot be interpreted as evidence successful intervention.

This is because bias within casual records may change over time, for example if a previously well watched area looses its' regular bird watchers, or if enthusiastic new birdwatchers begin submitting records for previously under recorded areas. These effects cannot be separated from real changes in bird abundance and distribution. Furthermore, even if increase in size and number of key-areas could be attributed to real population change, it may be the result of other effects, such as climate change or economically driven agricultural change, rather than benefits of an agri-environment scheme. However, the advantage of large quantities of records outweighs the disadvantage of unknown biases when the data are only used for targeting conservation action to main population centres.

How will the maps be used?

The key-area maps highlight the restricted ranges of priority species in Wales (Fig.1). Although all data on which they are based did not follow a formal method and are likely to be incomplete for most species, using these maps will ensure measures for these birds are implemented in places where they still occur. In Wales, this information is being used to inform targeting of prescriptions within the Tir Gofal agri-environment scheme as well as other conservation initiatives.

Key-area maps and guidance notes highlighting species requirements have been provided to the Welsh Assembly Government for nine birds, along with Principal Biodiversity Species in other taxa, such as Marsh Fritillary butterfly, Water Vole and arable weeds. These are assisting Tir Gofal Officers in selecting the most appropriate prescriptions for agreements within key-areas for particular priority species. In England, the information on target species distribution is made publicly available to landowners through online interactive maps at www.natureonthemap.org.uk and as downloadable distribution maps.

Key-areas for some different bird species from other taxa overlap, and this could result in conflicting management objectives if their resource requirements differ. Managing species conflicts is now being addressed by the partners involved in this project.

The importance of bird-watching

One of the many contributions that birdwatchers make to help the conservation of priority birds of farmed habitat is clearly demonstrated by high proportion of their records used in delineating key-areas. We would take this opportunity to thank those that submit records through County Bird Recorders, BirdTrack and NBN Gateway, and encourage this to continue and for others to do so. Further records of the nine species covered here will always be valuable, in addition to records for the following species for which key areas are being developed: Golden Plover *Pluvialis apricaria*, Woodcock *Scolopax rusticola*, Nightjar *Caprimulgus europaeus*, Yellow Wagtail *Motacilla flava* and Ring Ouzel *Turdus torquata* (breeding records): Red Grouse *Lagopus lagopus scoticus*, Lesser-spotted Woodpecker *Dendrocopus minor*, Marsh Tit *Parus palustris*, Willow Tit *P. montanus*, Hawfinch *Coccothraustes coccothraustes* and Twite *Carduelis flavirostris* (all records).

Equally, if not more important, are records of those high priority species for which it has not yet been possible to produce key areas, such as Bullfinch *Pyrrhula pyrrhula*, Grasshopper Warbler *Locustella naevia*, Cuckoo *Cuculus canorum* and Starling *Sturnus vulgaris* (breeding records). This is because the number of records currently available represents too small a proportion of the whole population.

The essential details needed for a record to be added to the BCTP are: date, species, number present (including count unit i.e. individual or pair), breeding status (nest found, territorial, in breeding habitat, or non-breeding), and location (at least four figure grid reference). Records can be submitted to County Bird Recorders (contact details in the annual Welsh Bird Report), or on line through BirdTrack (www.birdtrack.net) or the NBN gateway (www.nbn.org.uk).

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THE WOODLARK AND DARTFORD WARBLER SURVEYS IN WALES IN 2006

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SUMMARY

Results are given for the 2006 surveys of Woodlarks and Dartford Warblers in Wales. One pair of Woodlark nested and there were an estimated seven territories of Dartford Warbler.

INTRODUCTION

National surveys of both Woodlark *Lullula arborea* and Dartford Warbler *Sylvia undata* were organised in 2006, by the British Trust for Ornithology (BTO), Natural England (NE), Forestry Commission-England (FC-E) and the Royal Society for the Protection of Birds (RSPB).

There have been two previous national Woodlark surveys, in 1986 (Sitters *et al.* 1996) and 1997 (Wotton & Gillings 2000). In 1986, 241 territories were found in the UK, and by 1997, 1552 territories were found, an increase of more than fivefold. No Woodlarks were recorded in Wales in either of these surveys, however, with the last confirmed breeding record being around 1981, in Radnorshire (Lovegrove *et al.* 1994). Woodlarks were considered to be widespread, but scattered in the 1950s (Lovegrove *et al.* 1994) and were recorded in 20 10-km squares during the 1968-72 breeding bird atlas (Sharrock 1976).

National Dartford Warbler surveys have been undertaken in 1974 (Bibby & Tubbs 1975), 1984 (Robins & Bibby 1985) and 1994 (Gibbons & Wotton 1996), although it was known that there were only 11 territories in the UK in 1963, following two successive hard winters (Tubbs 1967). By 1974, there were an estimated 560 territories, but there were only 420 territories in 1984, with the decline attributed to major heathland fires between the two surveys (Robins & Bibby 1985). An estimated maximum population of 1,889 territories was recorded in 1994 (Gibbons & Wotton 1996), a more than fourfold increase since 1984. Until the mid to late 1980s, the Dartford Warbler was a rare visitor to Wales, with only six previous records noted by Lovegrove *et al.* (1994).

The aims of the surveys were to produce an accurate and precise population estimates for Woodlark and Dartford Warbler in the UK and to describe the current distributions accurately.

METHODS

For both species, survey coverage was based on 1-km squares, rather than on sites, and the aim was to completely cover a set of 'core' squares, those squares that were occupied during the last national survey and subsequently, and to survey a random selection of 'sample' squares from an area around the defined core squares.

Woodlark at a site near Trellech in Monmouthshire, by Ray Armstrong

Given the scarcity of Woodlark records in recent years, it was not possible to formally survey the species in Wales, so any coverage was based on observer-selected sites.

For Dartford Warblers, a list of 'core' survey squares were collated that was initially based on occupied 1-km squares between 1994 and 2005 was collected from a number of sources, including county bird recorders, the BTO regional network and records from RSPB Wales. Any relevant data were also extracted from national BTO/RSPB/JNCC Breeding Bird Survey (BBS) and from the BTO/RSPB/BirdWatch Ireland 'BirdTrack' online bird recording scheme. This process identified 20 core 1km-squares.

A stratified random sample of squares, based on habitat suitability, was selected from 5km and 10km buffers around the 20 core squares (Figure 1). In the 5km buffer, 64 squares were selected, and in the 10km buffer, 61 squares were selected.

Each 1-km square was visited at least twice from the beginning of April to the end of June. The first visit was made between 1st April and 15th May and the second between 16th May and 30th June, with a minimum of ten days between each visit. It was strongly suggested that visits were undertaken between dawn and mid-morning on mild, dry days with little wind, with cold, wet or windy conditions avoided where possible. All areas of potentially suitable habitat within the survey squares were covered. The locations of any Dartford Warblers seen or heard were recorded on to a site map, using standard BTO mapping symbols (Bibby *et al.* 2000), including simultaneous records of singing males or other territorial birds.

Volunteer surveyors, primarily through the BTO regional network, undertook the majority of the fieldwork. Staff from the survey partners and other conservation organisations were also heavily involved in this fieldwork.

RESULTS

For Woodlarks, five 1-km squares were specifically surveyed, two in Gwent, two in Gwynedd and one on Anglesey. Two of the squares in Gwynedd encompassed an area of farmland that held a wintering Woodlark during 2005/06. A pair of Woodlarks was found in Gwent, the first confirmed nesting in Wales since1981. It was confirmed that the pair bred, with one clutch that failed and a subsequent brood of four (Lewis *et al.* 2007).

For the Dartford Warbler survey, 117 1-km squares were surveyed in Wales in 2006 (Figure 1). Dartford warbler territories were recorded in 25 1-km squares (Figure 2). Ten core squares were occupied, out of 15 surveyed, containing 21 territories. In the 5km buffer sample, 39 squares were surveyed and three territories located. The 5km buffer estimate was calculated to be 29 (95% CL, 3-67) territories. No Dartford Warbler territories were found in the 32 10-km buffer sample squares surveyed in Wales.

An additional 31 1km-squares were also surveyed that were not core or sample squares. Two of these extra squares were records from the BirdTrack website that were added during the survey period, with the others selected for coverage by observers. In the 31 extra Wales squares a maximum of 17 territories were recorded, in 12 1km-squares.

Four territories were recorded beyond the 10-km buffer zone, all in Carmarthenshire. The final Dartford Warbler population estimate for Wales in 2006 was 72 (95% CL, 41-116) territories (Wotton *et al.* in prep.).

Dartford warblers were recorded in Carmarthenshire (10 territories), Glamorgan (12 territories), Gwent (4 territories) and Pembrokeshire (15 territories). The altitude of territories ranged from 7m a.s.l. in Carmarthenshire to 431m a.s.l. on the Brecon Beacons.

Figure 1. The Dartford warbler survey 5-km and 10km buffers, and the distribution of the 117 1km-squares surveyed in Wales in 2006.

Figure 2. The distribution of the 25 1km-squares occupied by Dartford warblers in Wales in 2006.

CONCLUSIONS

It is encouraging that a breeding pair of Woodlarks was recorded in Wales during the 2006 survey (Lewis *et al.* 2007). There are encouraging signs from the survey results in England to suggest that Woodlarks could become established again in Wales, especially in the east. There has been a substantial increase of 88% between 1997 and 2006, with 3064 territories (95% CL 2472-3687) estimated in 2006, and signs of a range increase in the West Midlands (Conway *et al.* in prep.). The closest Woodlarks to the Gwent pair were in Worcestershire, at a distance of about 70km.

In Wales, there has been an encouraging spread of Dartford Warblers along the south coast since the first breeding record in Gwent in 1998 (Williams 2000). Although most territories were found on heathland on or near the coast in Carmarthenshire, Glamorgan and Pembrokeshire, there were four territories on upland heath in the Brecon Beacons. The 2006 UK population estimate was 3212 (95% CL, 2876-3589) territories (Wotton *et al.* in prep.), so the Welsh numbers represent 2% of the UK total.

There is much potentially suitable habitat for Dartford Warblers in Wales now, particularly when considering their recent increases on Dartmoor and Exmoor in southwest England (Wotton *et al.* in prep). As the Dartford Warbler has recently been classified as 'Near Threatened' by BirdLife International, due to large declines in the

core population in Spain (BirdLife International 2008), the UK population could become increasingly important over the coming years.

Searches of suitable habitat during the coming breeding seasons may prove to be increasingly productive in the search for new Dartford Warbler territories in Wales.

ACKNOWLEDGEMENTS

Thanks go to the local BTO Regional Representatives in Wales, particularly Annie & Bob Haycock, Bob Howells, Colin Jones, Jerry Lewis, Rob Nottage and Bob Tallack, the voluntary surveyors who took part in the survey and all landowners who granted permission for access onto their land. Reg Thorpe and Andy Young helped with the survey preparations. The national survey was funded by Forestry Commission (England), JNCC, Natural England and RSPB.

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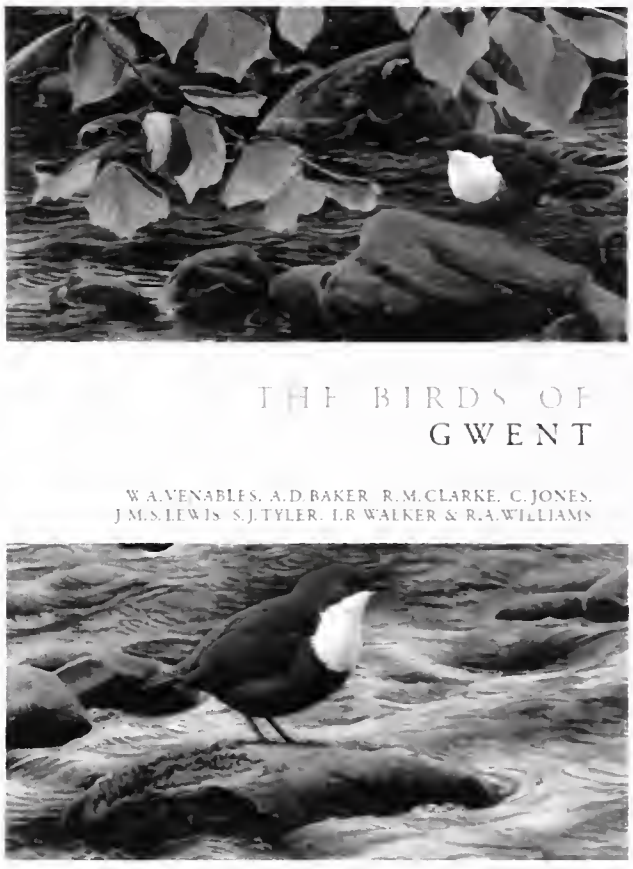
The Birds of Gwent

Produced by the Gwent Ornithological Society,
by Venables, Baker, Clarke, Jones, Lewis, Tyler, Walker and Williams.
Published by A & C Black
ISBN: 978-0-7136-7633-4
Price £40.

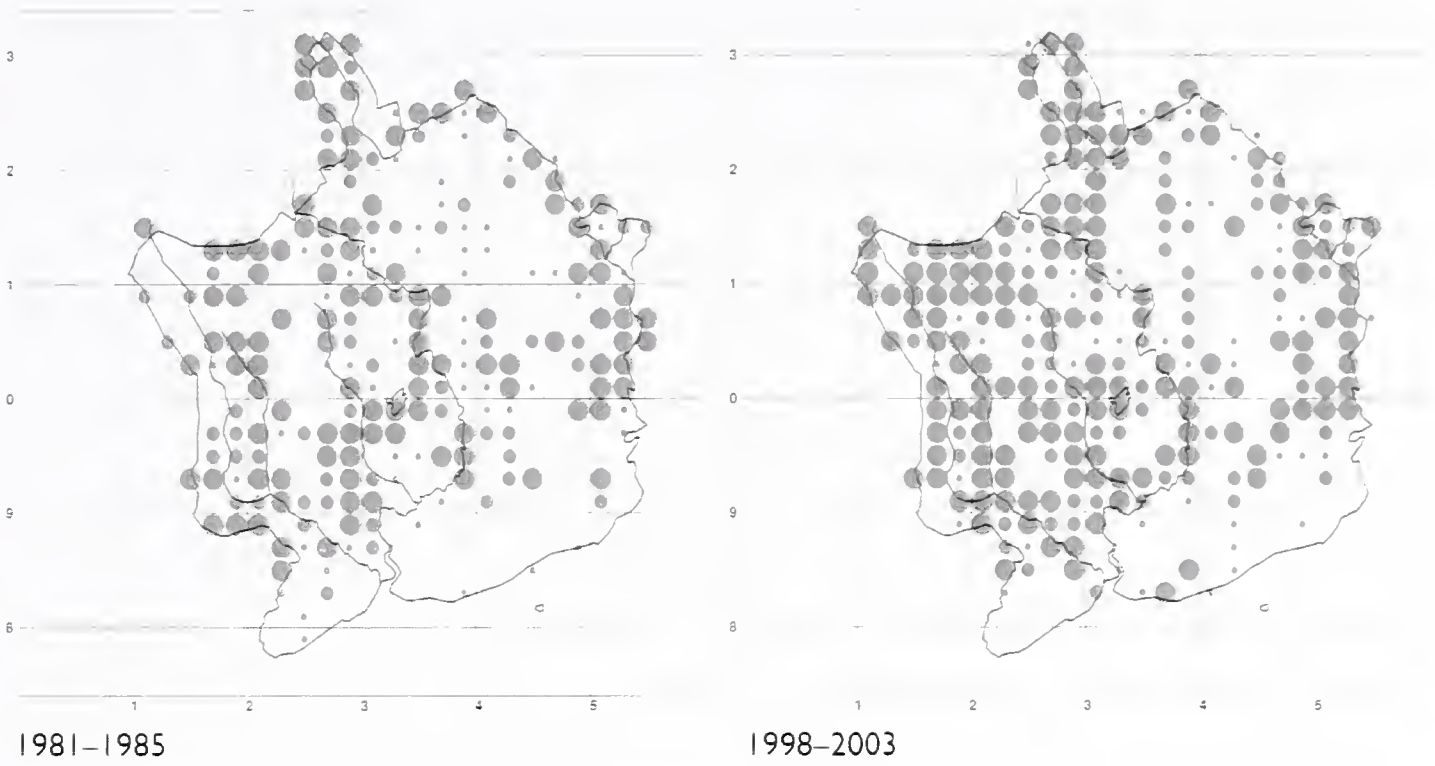


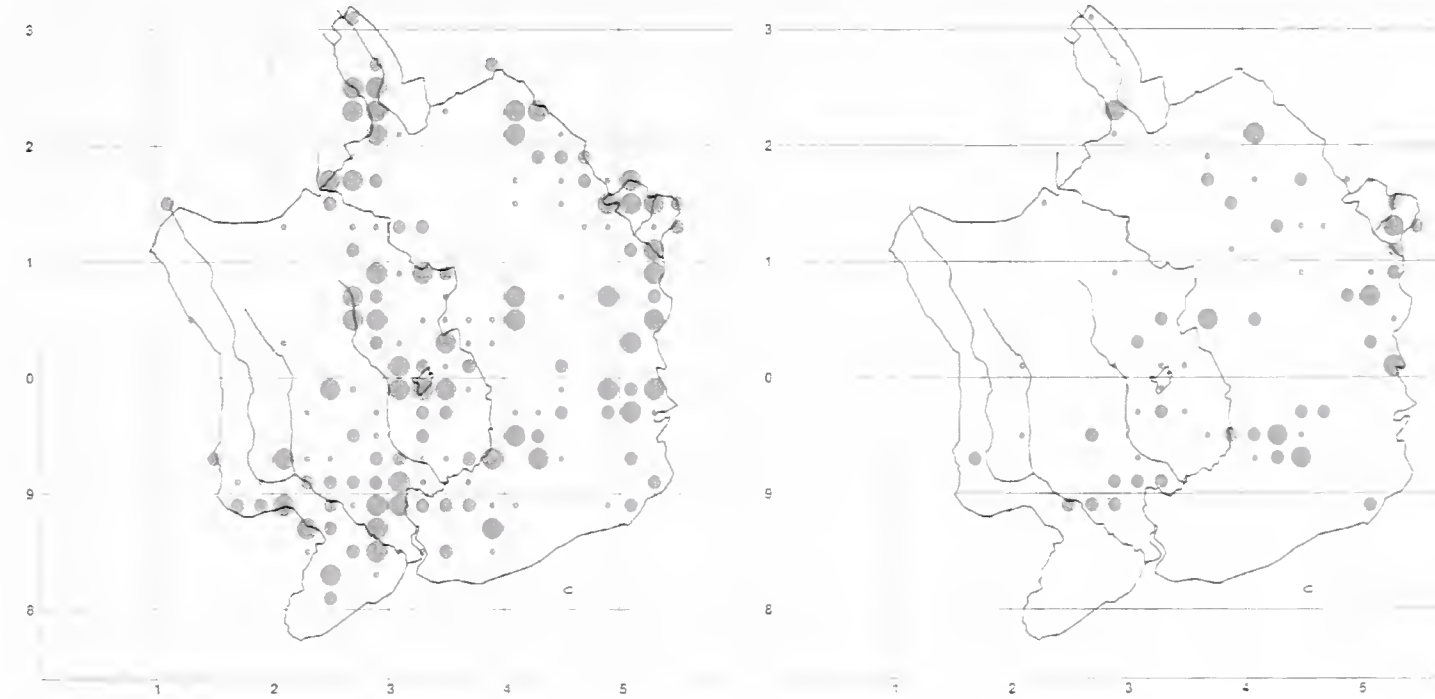
The Birds of Gwent is one of the first comparative breeding bird atlases for a county in the UK, never mind Wales and as such it sets the standard for the rest to follow. Not only does this hard-backed book give a complete historical run-down (superseding the original Birds of Gwent, published in 1977) but more interestingly it compares the original county atlas, of 1981-5 (published in 1987) with the most recent one of 1998-2003.

Credit where credit is due, this is the third tome to be produced by the Gwent Ornithological Society. This time the printing and publishing has been greatly assisted by A & C Black, with their knowledge, experience and finance the new edition has been able to take the form of a decent sized, hardback, along with colour photos and a fine dust cover showing a pair of Dippers on the front (obviously not from the county as all Dippers in Gwent have been ringed by two of the authors) and two Hawfinches on the reverse, both sets of illustrations by John Gale.

The contents take the usual form, with chapters on "The County of Gwent", Geology, Bird Habitats, "Where to watch birds in Gwent", "The Gwent Breeding Bird Atlas", a full systematic list, a list of species added to the county list since 1976 and selected ringing data, with many fine illustrations dispersed throughout the book by Chris Hodgson, Steve Roberts and Helen Scourse. Of interest are the additional sections on "Conclusions and Comparisons", "Estimates of Breeding Populations" and "Summary of tetrad data", where the authors have taken the time to look at the significant changes since the last atlas. In fact this theme of comparison is the thing that makes this book stand apart from others. Right through the systematic list, where ever possible, comparisons are drawn between the two tetrad atlases (1981-5 and 1998-2003) and other published data, including CBC/BBS indices, existing Welsh population estimates (from Birds in Wales and Birds in Wales 2000) and "The State of Birds in Wales 2003". It really brings it home to the reader how our bird populations are changing, many residents are on the increase, while our summer migrants on the whole are not doing so well.

I particularly liked the use of colour for the maps and charts (as in the 1st atlas), both pleasing to the eye, breaking up the black and white text but also making the comparison between the atlases more easy.





Black & white scanned comparative maps for Grey Wagtail above and Willow Tit below.

One could quote species after species where the National Data (CBC/BBS) backs up the local situation, however there are a few that stand out as being anomalous – the Stock Dove for one, with a 68% increase 1985-2003 according to CBC/BBS yet the distribution map suggests otherwise. Green Woodpecker is another, where the Gwent atlases suggest a slight increase (+2%), yet Welsh CBC/BBS is -24%. It does and should make the reader ask questions as to the validity of some of these figures –

particularly the Welsh & UK CBC/BBS data. We appreciate that it may be statistically fair, random and the like, but where did the BTO get its data from? There is so much variation within one county never mind across Wales and the UK, that some of their National figures appear to be so wide of the mark.

One of the real difficulties of producing such a volume is the necessity of having a team of writers each doing a small section in their own way. The team leader has done a good job of keeping the style and format consistent throughout the text. In the vast majority of cases the amount of space given over to that species was about right. For only a few species did it appear that the writer was going over the top – particularly on historic records and not putting as much emphasis on more recent periods. Similarly a few species could have been expanded upon, e.g. Yellow-legged Gull, where there is a bland summary of the more recent records, when some sort of chart or map of sightings would have meant a lot more. I didn't feel the need for the comparative monthly tables for Little and Black Terns, as there was marginally any difference between the years (unless that was what the writer wanted to point out) a simple monthly distribution chart would have been clearer and meant the same.

This book has many plus points that it would be unfair to dwell on the negative aspects, of which there are barely a handful. I didn't see the point of having an appendix of excluded records (this gives them some sort of credibility, which they don't apparently deserve) and the records of presumed escaped individuals could have been included and flagged up in the main text anyway. Similarly the treatment of *Larus fuscus fuscus* should have been firmer (should have been published as withdrawn from the county list) as this race is not officially on the British List. I also felt that the colour photos (nice as they were) seemed to be in the wrong place, right at the front, whereas in the middle or divided 1/3 and 2/3 to split up the book – but presumably that was a publishing decision. My only serious gripe was that I would have liked to see more sites dealt with in the "Where to Watch Birds" section. For example, what about Nedern – it is mentioned often in the text yet surprisingly there is no site guide.

Seriously though, this is an excellent book and one to dip into again and again. Both A & C Black and the team of authors need congratulating on the production of such a fine volume. As I've already stated this sets the standard for all other county avifauna to follow. My only worry is that in most cases they won't be able to! So if you are interested in Gwent, how populations are changing or are interested in producing your own avifauna this book is a must.

Jon Green

WELSH BIRDS

'Welsh Birds' is the journal of the Welsh Ornithological Society and is published twice a year, in June and December. The December issue is primarily devoted to the Welsh Bird Report and the annual report on Bird Ringing in Wales.

Papers for 'Welsh Birds' are welcomed by the Editor on any aspect of Welsh ornithology. The Society is anxious that the journal should accurately reflect present ornithological activity in Wales. Thus we hope that all workers, professional or amateur, with results of bird studies in Wales, will always consider publishing information about these here. All papers will be reviewed by the Editor and an independent referee. Authors should follow the format of papers published in the journal and guidelines for authors have been drawn up and are available from the Editor (address on inside front cover). Papers are accepted and published in either Welsh or English. In accordance with standard international practice, papers in Welsh should be supplied with captions to tables and figures in both Welsh and English and with an English summary.

Short notes on interesting or unusual features of behaviour recorded in Wales are also welcomed. An accumulation of such items is of considerable value. Notes should be short and succinct, ideally of not more than half a page in length. Notes may also be submitted in either Welsh or English.

Printed by Clarke Printing, Monmouth